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# DEEP SKY

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Sailing aboard the Good Ship Argo Navis

Observing the Galaxy Group Around IC 698

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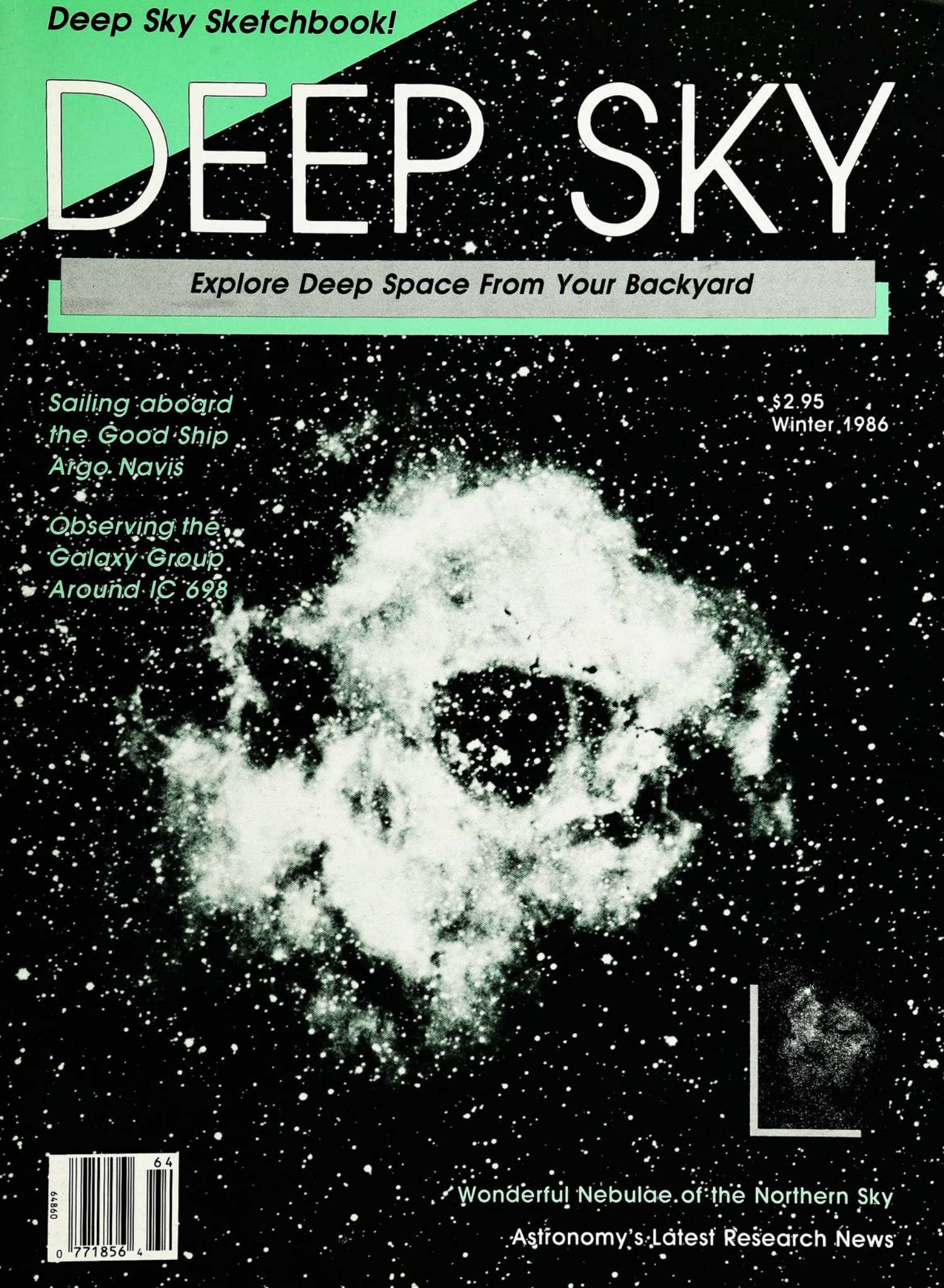
Winter 1986



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Wonderful Nebulae of the Northern Sky

Astronomy's Latest Research News

# DEEP SKY

**Sailing aboard the Argo Navis**
by Phil Harrington

6 *The ancient mythical constellation Argo Navis contained what is now Vela, Carina, Puppis, and Pyxis. During the eighteenth century Argo Navis was split into pieces, but the huge area of sky it once covered still contains many treasures for deep-sky observers.*

**Photographing the Northern Milky Way**
by Robert Reeves

14 *Unknown to many observers are scads of faint wispy nebulae lining the Northern Milky Way that, although difficult to spy visually, give themselves to filtered photographic plates with only a few minutes' exposure.*

**The IC 698 Galaxy Group**
by Jeffrey Corder

22 *Tucked away in Leo is a faint galaxy group containing seven members visible in large backyard telescopes within a single field of view. IC 698, the brightest, shines at 14th magnitude and covers 1' of sky.*


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***ON THE COVER: The Rosette Nebula photographed by Robert Reeves near San Antonio, Texas; 300mm focal length astrocamera, hypersensitized Tech Pan film, 30-minute exposure with Wratten #92 filter.***

# Inside View

**P/Skiff-Kosai and DDO 79**

*Brian Skiff [2]*

**Discoverer Brian Skiff at work**

All of us at *Deep Sky* heartily congratulate our Contributing Editor and resident genius on deep-sky data, Brian Skiff of Lowell Observatory. Early in September Brian noticed a fuzzy object on one of the U.K.-Caltech Asteroid Survey plates he was examining. The plate was taken by Charles Kowal in 1977, and upon checking the out-of-place object Brian Marsden recognized that Skiff's object was identical to one reported as an asteroid by the Japanese observer H. Kosai in 1977. The object was not an asteroid, but a periodic comet, which was designated P/Skiff-Kosai (1976 XVI). The photograph above is a section of Skiff's discovery plate. This is Brian's second comet, the first being 1983's Comet Bowell-Skiff.

The issue contains some pretty neat stuff. The lead article by New Yorker Phil Harrington is a travel guide to the vast reaches of the antiquated constellation Argo Navis. Once encompassing all that is now Puppis, Vela, Carina, and Pyxis, the good ship Argo Navis was decommissioned during the 18th century, thought by astronomers to be too big to stand alone. A surprisingly large number of fine objects lie in this region of the sky.

San Antonio's Robert Reeves is one of the finest astrophotographers in the country today. Beginning on page 14 is a portfolio of his magnificent shots of the northern Milky Way, including some little-known nebulae and star clouds.

The issue's third lead feature is a profile by Floridian Jeffrey Corder of a faint galaxy group in Leo called the IC 698 group. Barely perceptible in small telescopes, the clump of nebulosities becomes worthy of careful scrutiny in large aperture backyard instruments.

So many astronomy books appear on the market these days that it's a time consuming task to keep track of them. This issue's book review column features concise summaries of three recent books of potential interest to deep-sky observers and photographers. The column will continue to provide this service in future issues, and I will be glad to hear from any observers interested in writing short reviews of new books as they are published.

*DSM Reports* concludes Richard Berry's three-part series on plotting the RNGC database by computer. In working with galaxies around the south galactic pole, Richard discovered some strange aspects of the catalogue that have their origins in the 1830s and still greatly affect stargazing literature and even research projects today, a century-and-a-half later.

Yours truly,

Dave Eicher
Editor

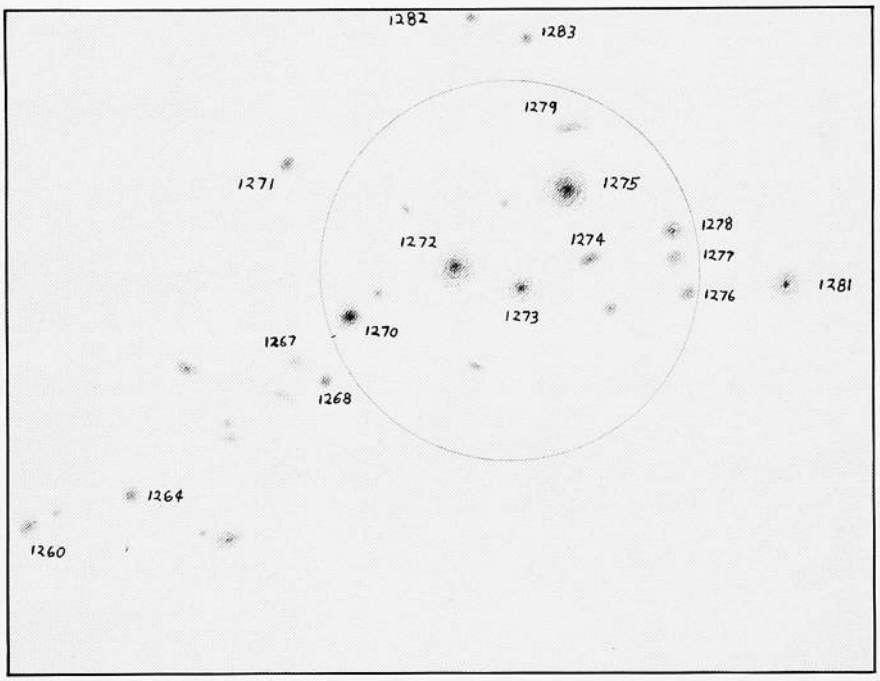
# Letters to DSM

## Stumbling on an Abell Cluster

Dear Dave / Has anybody ever stumbled across an Abell cluster? Abell 426 is one group of galaxies that I didn't mind bumping into. While having one of our typical observing sessions with a 20-inch f/5.6 reflector at a dark site, Ron Parmentier and I encountered this galaxy cluster by accident.

After observing about a dozen faint galaxies on the night of October 11, we placed the setting circles on NGC 1260. Expecting to see a grand total of two galaxies in the field of view, we saw instead a string of five galaxies. This

Dan J. Sheber, Jr.




*Abell 426 sketched with a 20-inch telescope.*

sent us running in a panic for volume 5 of the Webb *Society Deep Sky Observer's Handbook*. We were startled, as this group appeared unique because of its stringlike shape. The Webb book identified the group as Abell 426.

The enclosed sketch contains approximately 90 percent of the galaxies within this group. The background stars have been excluded to avoid overcrowding and confusion. The circle on the sketch indicates the field of view resulting from a magnification of 199x.

I am rather interested to hear about other observations of Abell 426. Ron and I plan to observe Abell 426 again in 1987 using a 30-inch telescope and will be anxious to see if it appears differently in the 20-inch scope.

Dan J. Sheber, Jr.
3240 Lancelot Lane
Green Bay, WI 54301

## Observing from Down Under

Dear Dave / The deep-sky views in Australia have caught me and may not let me go!

The view of the Eta ($\eta$) Carinae Nebula is simply incredible. Omega ($\omega$) Centauri viwed overhead is great, but doesn't approach the Tarantula Nebula, NGC 2070. Wandering through the Large Magellanic Cloud is far more interesting than wandering through the Coma/Virgo cloud. The dark nebulosities along the galactic plane are also more evident than their fellow nebulae up north.

When I'm not using my 4.5-inch reflector, I borrow a friend's 17.5-inch Dobsonian. Recently I was looking for NGC 2467 in Puppis, a small nebula involved with a star cluster. The nebula appeared interesting without a filter, so just for kicks I tried the OIII filter which I had purchased months ago but hadn't yet tried due to weather. The filter increased the nebula's size dramatically, adding a section following the cluster, and fading off out of the lower power view!

Spurred on by this discovery, I aimed the scope at Eta Carinae and, with the filter, the view blew my mind. The nebula showed all sorts of detailed wisps of nebulosity, and the dark lanes were jet black. For the rest of the night I tried the OIII filter on everything I could find, comparing the view to that of a premium deep-sky filter. Naturally there were objects which showed no improvement, or "died" completely, but when the filter worked, WOW!

With the success at Eta Carinae, I tried the standard Sagittarius area showpieces. The Lagoon Nebula appeared to be right out of a long exposure photograph and easily rivalled the typical view in a 24-inch telescope. The filter helped remarkably on the Dumbbell Nebula, even at a fairly low altitude; the "wings" were completely filled in with nebulosity. The Trifid Nebula showed the least improvement.

Using that filter on two nights with the 17.5-inch telescope more than justified the trip.

With still over a month to go, I still have to tackle the Large Magellanic Cloud. I don't know where to start! At the moment, with a First Quarter Moon in the sky, I'm picking up things in southern Sagittarius and Scorpius that are too low or are scraping the horizon back home. These observations should be useful for making comparisons later.

Alister Ling
c/o Richards
7 Nepean Street
Glen Iris, Victoria, Australia 3146

[Ed. note: I received this letter from Alister when he was on holiday in Australia observing Halley's Comet and other delights. His permanent address is 1865 St. Catherine W #5, Montreal, Quebec, Canada H3H 1M2.]

## Shoot the Right Telescope!

Dear Mr. Eicher / The Fall 1986 issue of *Deep Sky* contains an error on page 21 beneath the photograph of the McDonald Observatory 82-inch reflector. As it reads, the photo caption states that the 82-inch mirror was cracked by pistol shots fired by a deranged graduate student.

The 82-inch telescope was never harmed in this manner. Your writer has garbled the story. In February 1970 a new observatory employee broke down mentally and carried a pistol into the dome of the 107-inch telescope, which had been dedicated in November 1968. After firing one shot at his supervisor, he discharged the magazine directly into the fused silica mirror of the telescope. Due to the hardness of the silica, the mirror did not break, but was scarred with pock marks at the impact points. The damage was bored out and the depressions painted black to diminish the scattering of light. The consequence was an effective light loss so that the telescope is more nearly a 106-inch than

a 107-inch.

You may read for yourself a good popular history of McDonald Observatory and especially the 82-inch Struve telescope by obtaining a copy of the newly-released book *Big and Bright: A History of the McDonald Observatory*, by David Evans and J. Derral Mulholland. Contact the University of Texas Press, P.O. Box 7819, Austin, TX 78713.

James Bryan
The Nancy Lavender
Astronomical Observatory
605 San Gabriel Overlook East
Georgetown, TX 78628

— Deep Sky *regrets the error.*

## How Small Is That Telescope?

Dear Sir / In the January 1980 issue, when your magazine was called *Deep Sky Monthly*, Alan Goldstein asked if a 6-inch aperture was the smallest that would reveal the galaxy NGC 6946 in Cepheus. That question stuck in my mind and was put to the test on October 8, 1986.

It was a clear night, but not exceptionally so. I was making an intense study of Cepheus with small apertures and got my first view of the ancient open cluster NGC 188 using my 4.25-inch f/7 reflector at 38x. My 2-inch f/12 Jaegers refractor at 25x also showed NGC 188 as a dim glow and even a 10x40 Unitron finder let me "suspect" the cluster. This encouraged me to look for the low surface brightness galaxy 6946, using the nearby cluster NGC 6939 as a guidepost. The galaxy showed in the 4.25-inch reflector at 38x. To my amazement, switching to the 2-inch scope at 25x, the galaxy remained visible! These observations confirm Brian Skiff's statement in the March 1981 *DSM* that an optimum magnification is 5x per cm (12.5x per inch) of aperture for dim extended objects, which gives a 2mm exit pupil.

Gus Johnson
RD 2, Box 67
Swanton, MD 21561

## Studying Good Ol' NGC 1

Dear Dave / Last year in an issue of *Deep Sky* there appeared a drawing of the little observed galaxy NGC 1, along with a suggestion that somebody should contribute a photograph of it. As it happens, I have been interested in this galaxy for several years and have photographed it a few times.

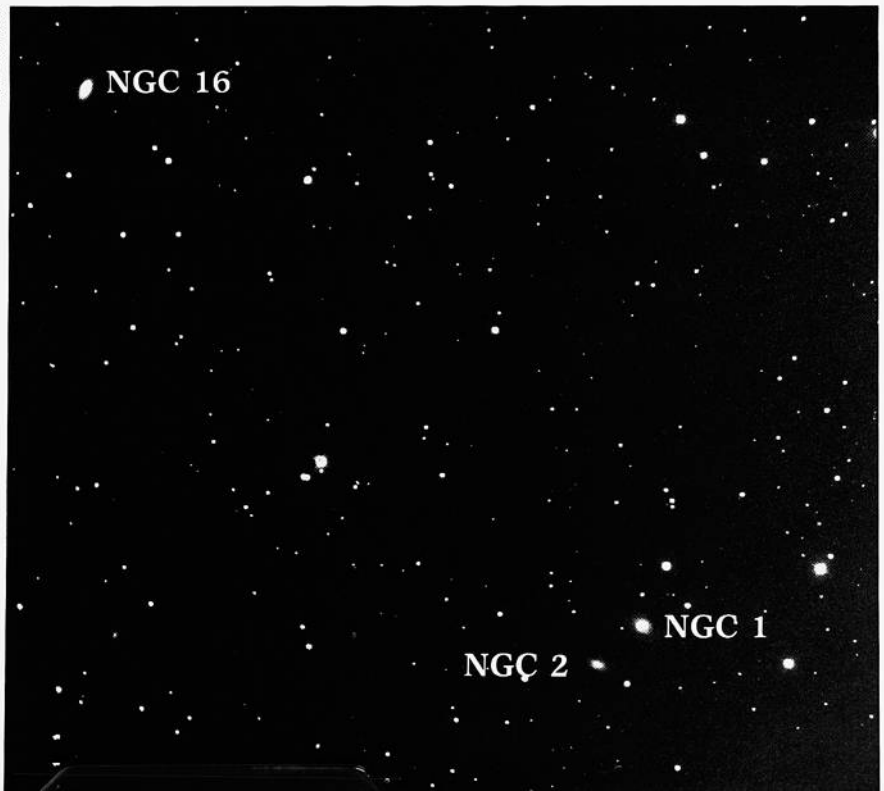
The enclosed photograph was taken on September 28, 1986. I used the 16-inch f/5 telescope at the Peninsula Astronomical Society's observatory in the Santa Cruz Mountains about 50 miles south of San Francisco. The photo was made with hypered Tech Pan film printed on Ilford multigrade at the highest possible contrast level. I have marked the locations of NGC 1 and its neighbor NGC 2 lightly in pencil on the back of the print, along with the bright galaxy NGC 16, which appears on the Tirion atlas.

Good luck with *DSM*; you'll be hearing from me again.

Bill Sorrells
2503 Santa Rita Road, #35
Pleasanton, CA 94566

*Thanks for sharing the excellent photo, Bill. We can all congratulate you on discovering Comet Sorrells (1986n), a 12th-magnitude object discovered on November 1, 1986, on a photographic plate. May you have many more successes! — DJE.*

*Bill Sorrells*




## Editorial Correction

The Editors of *Deep Sky* have received word from the Kentucky astrophotographer Jack Metcalfe that his photograph of NGC 7662, published in the Summer issue, was actually a photograph of NGC 3242. We usually keep our planetary nebulae straight and regret the error.

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# Sailing aboard the Argo Navis

by Phil Harrington

It's that time of year again: there's a chill in the air and snow is in the forecast. Wouldn't it be great to be on a cruise bound southward? Well, I can't offer you a real ship, but I can take you on a celestial voyage aboard the mythological ship *Argo Navis*. Readers may be familiar with the tale of *Argo*, the ship built by Argos for Jason set sail on the ship with a crew of fifty Argonauts in search of the Golden Fleece. When their voyage was over, Athena placed the boat in the sky.

The ancient constellation of Argo never rose much above the southern horizon from what would be middle America, but it contained over eight hundred naked-eye stars within its huge borders. Because it was so vast, astronomers of the late nineteenth century divided Argo into four component constellations. We know them today as Puppis the poopdeck, Pyxis the compass, Vela the sails, and Carina the keel.

For Northern Hemisphere observers, **Puppis** is the most familiar part of Argo. It lies east of Canis Major in an area notably devoid of bright stars. Yet Puppis is rich with telescopic treasures. Binoculars reveal dense starfields with many bright open clusters intermingled like islands in a vast stellar ocean.

One of the open clusters easiest to spot is **M47** (NGC 2422). Its 117 stars range from 6th to 14th magnitude, which give it a total integrated magnitude of 5. Under a dark sky keen-eyed observers can pick out the open cluster with the naked eye. Low-power, wide-field eyepieces will give the best view of its 20′-wide expanse.

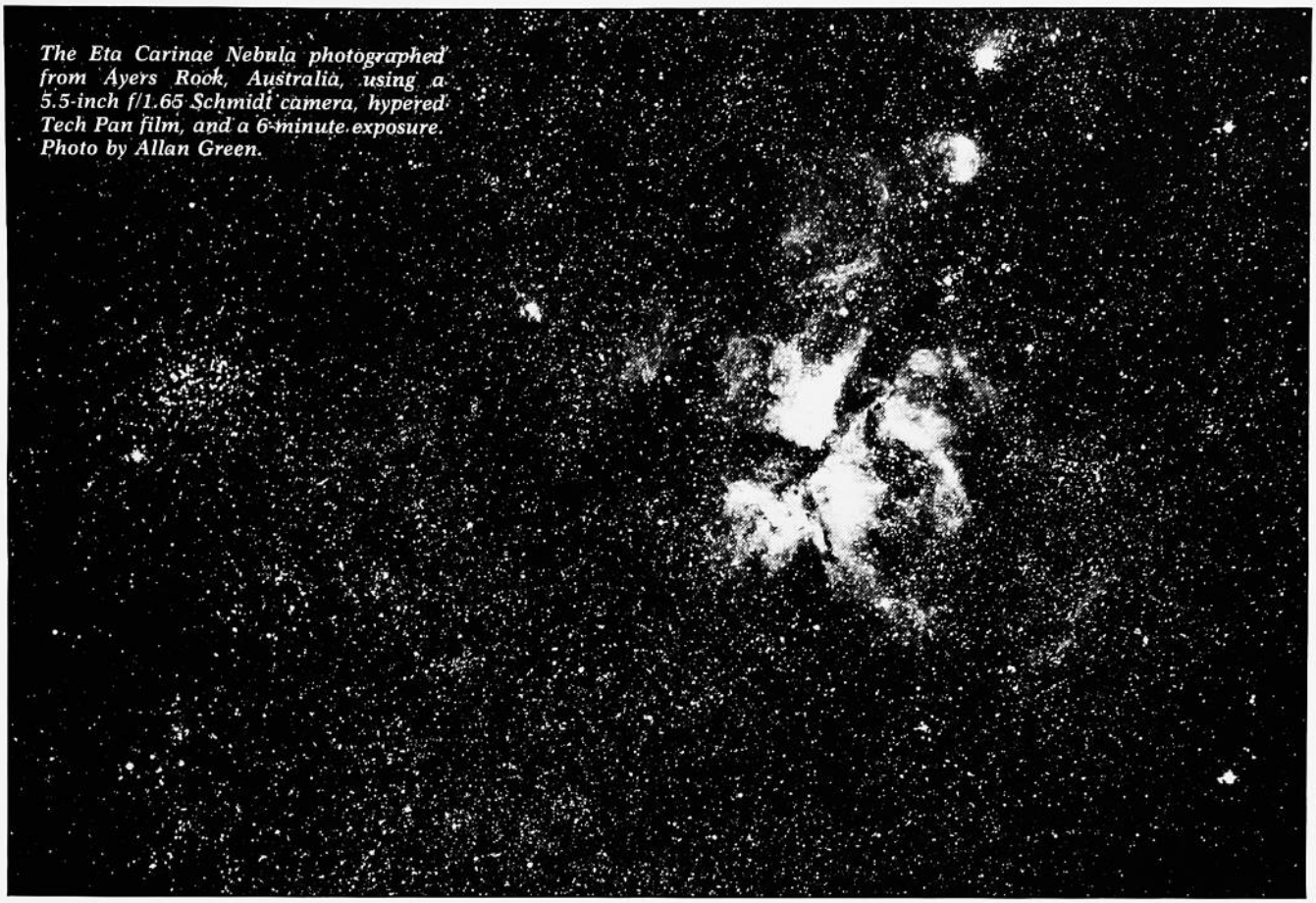
Our next target is only a hop away from M47. Shift 1¼° east to find **M46** (NGC 2437). Both M46 and M47 were discovered by Charles Messier in February 1771. M46 is a rich congregation of at least 150 stars ranging from magnitude 9 to the limits of your telescope. Binoculars will show only a hazy glow, while a 4-inch instrument is capable of achieving partial resolution. My 8-inch f/7 reflector displays a dense swarm of dim points of light.

If you have at least a 3-inch telescope, take a careful look in the northern part of M46. There you'll find **NGC 2438**, a tiny planetary nebula. It glows softly at 11th magnitude and measures 65″ in diameter. Studies over the past two decades show that the cluster and the nebula are not related. M46 is thought to be 1.7 kiloparsecs distant and receding from us at 40 kilometers per second, whereas the planetary is 1.0 kiloparsec away with an estimated recession of 75 kilometers per second.

The differences between the structure and stellar content of M46 and M47 are visually striking. M47 is irregularly concentrated with a wide range of star brightnesses, while M46 looks like a loose globular with stars of much more uniform brightness.

**NGC 2423** lies just north of M47. My 8-inch resolved sixty stars within the 20′ boundary of this galactic cluster. Identification is easy with a low-power eyepiece. A 2-inch scope shows about two dozen stars in this group, while larger apertures show a 9th-magnitude red star north of the group's center. **Melotte 71** lies about 1.5° farther north. Some patience may be required because this cluster is quite small and its stars quite faint. A 2-inch scope shows the group as a high surface brightness patch. Your careful search will pay off with a view of a very compact, little-knwon swarm of about sixty-five stars.

Move back to M46 and drop 3.3° due south to find **NGC 2440**, another planetary nebula. Although most catalogues list it at magnitude 11.5, equal to NGC 2438, I find that NGC 2440 is easier to spot. (Jack Marling's recent estimate of the planetary's brightness is magnitude 9.4.) Its 50″ by 20″ oval disk glows with a distinctly greenish hue, which makes it stand out against the stars of the winter Milky Way. The nebula's central star is 14th magnitude, which means that some of the largest backyard scopes might show it. The open cluster **NGC 2432** may be



*The Eta Carinae Nebula photographed from Ayers Rock, Australia, using a 5.5-inch f/1.65 Schmidt camera, hypered Tech Pan film, and a 6-minute exposure. Photo by Allan Green.*

found a little farther to the southwest. Only about twenty dim stars form this group. Smaller instruments fail to reveal more than a faint nebulous glow, while 8- to 10-inch scopes reveal some of its stars.

Several other open clusters in this neighborhood are worth observing. **NGC 2479** is a rich, circular patch of faint stars. A curious lack of stars toward the cluster's center make the cluster look ring-like. Bordering this "hole" on the north side is a prominent 180° arc of bright stars. NGC 2509 is a striking stellar collection. Many magnitude 9 and fainter stars are compressed within a triangular frame of brighter stars. The best views come with moderate magnifications of about 100x.

**NGC 2539** is located further north, practically on top of 19 Puppis. Under dark skies the combined light of its one hundred suns allows it to be seen easily in binoculars or a finder scope. Larger instruments display its 9th- to 11th-magnitude constituents scattered about 19 Puppis, an unusual quadruple star system. The 5th-magnitude primary is surrounded by magnitude 11, 13, and 9 secondary suns at p.a. 245° (separation 1.8″), 299° (33.3″), and 276° (60.5″), respectively.

Intermingled with these clusters is a lone galaxy, which is the northernmost object in our survey. **NGC 2525** is a dim barred spiral, situated on the Puppis-Monoceros border. It can be seen in an 8-inch scope, although finding it will prove much easier in a larger instrument. Look for a small 12th-magnitude oval smudge of light. Its surface seems uniform with no visible central nucleus even with high magnification.

Next we encounter **NGC 2421**. Look for a small, rich aggregation of about sixty faint stars compressed within a mere 8′. Another open cluster in the vicinity is **NGC 2455**. It comprises a third as many stars as 2421. Moderate power works well for both clusters, allowing full resolution in a 6-inch scope on dark nights.

Scan farther southward to our next stop, the open cluster **M93** (NGC 2447). Messier was the first to stumble upon this cluster back in March 1781, when he described it as a "cluster of small stars...between Canis Major and the prow of [Argo] Navis." M93 is a pretty sight in amateur telescopes; it is even quite attractive in finder scopes. Look for a distinctly triangular gathering of about fifty stars. Larger binoculars offer a particularly nice scene of M93 silhouetted against the rich surrounding starfields.

To the east is **NGC 2482**. About fifty dim suns belong to this rich galactic family. Because its stars are spread across an 18′ field, this is an easy cluster to catch with low power. Look for it about 1.5° east of the double star Xi (ξ) Puppis. Now drop 1.5° due south, and you should spot open cluster **Trumpler 9**. It appears as a small, scattered collection of about ten magnitude 9 and fainter stars. **NGC 2467**, a patch of bright nebulosity, is in the same field of view. It surrounds an 8th-magnitude star and appears as a formless glow from a typical observing site. (It is fine and detailed from a dark-sky site.) A second open cluster, bordering it to the east, plays host to nine pretty faint stars.

**NGC 2453** is an easy target northeast of 1 Puppis. My notes recall a bright, rich open cluster populated with many 9th-magnitude and fainter stars. Nearly superimposed on it is 12th-magnitude **NGC 2452**, a small planetary nebula. I have never been able to catch a glimpse of this small cloud, but you might have better luck. Don't get your hopes up about seeing its central star — it dimly glows at 19th magnitude.

About 4° south of Rho (ϱ) Puppis is **NGC 2527**. This is a grouping of about forty magnitude 11 and fainter stars, with an 8th-magnitude star lying on the eastern edge. **NGC 2533**, a smaller galactic cluster, is 1.5° farther south. About forty faint stars compose the object, all richly crammed into 8′. A 6-inch scope should be able to resolve

*The bright open cluster M93 in Puppis is one of the finest small clusters in the southern Milky Way. Located in an exceedingly rich starfield and shining at 6th magnitude, M93 contains 80 stars of magnitude 8.2 and fainter in an area 22′ across. Photo by Lee C. Coombs; 10-inch f/5 Newtonian, 103a-F emulsion, and a 5-minute exposure.*

at least some of these, though smaller scopes might have a harder time.

**NGC 2489** is a small, dim open cluster located just north of a trio of 5th- and 6th-magnitude stars. The cluster itself consists of about thirty faint suns, and it may prove unresolveable in an instrument with less than a 6-inch aperture. Now, aim about 4° farther southwest and **NGC 2439** should come into view. If you had trouble with 2489, I think you might find this open cluster a little easier to find. In fact, NGC 2439 appears as a 7th-magnitude glow in binoculars and finder scopes, while larger instruments reveal about fifty 9th-magnitude stars tightly bound within 9′. The brightest star in this group is 7th-magnitude R Puppis, a variable star.

Globular cluster fans take heed — you have not been forgotten! **NGC 2298** is tucked just inside the western boundary of Puppis. Few observers pause to view this 9th-magnitude globular, yet it appears as a fairly bright, easily distinguishable sight in my 8-inch scope. Resolution is another matter, however. A 10-inch telescope at least is required, especially from mid-northern latitudes.

The next two objects on our tour are faint galaxies. **NGC 2310** lies about 7° southwest of Pi ($\pi$) Puppis, near a pair of 7th-magnitude stars. Look for a small, 12th-magnitude, cigar-shaped blur. **NGC 2427** won't appear any more impressive, if it appears at all. Many readers will be unable to pick this barred spiral (at declination −48°) out of the haze. It shines at magnitude 12.5 and measures 5′ by 3′, which gives it a very low surface brightness.

Now move northward to **NGC 2451**. Binoculars or a rich-field telescope works best, since this open cluster is scattered over 30′. I can pick out about twenty stars of magnitudes 6 to 11 in my 4¼-inch f/4 RFT from the dark sky at the Custer Institute on Long Island. The group is highlighted by 4th-magnitude c Puppis, a very red star that shines at magnitude 3.6.

Nearby, just north of b Puppis, lies **NGC 2477**. This is an unusually rich open cluster that offers a striking view in backyard scopes. Over one thousand faint stars combine to produce a 6th-magnitude glow that makes this cluster easy to spot. As with the stars in 2451, the cluster stars of 2477 are spread across nearly 30′, so use an RFT or your widest field eyepiece. Once you spot NGC 2477, it's sure to become a winter favorite.

A third large open cluster may be found to the east. **NGC 2546**, a naked-eye object, is a loose grouping of about fifty stars ranging from magnitudes 6 to 11. Once again my 4¼-inch RFT produced a more pleasing view than my 8-inch because of the cluster's 30′ diameter. Just the opposite is true of **NGC 2568**. It appeared as nothing but a dim glow some 2′ across, although this was probably partially due to its low altitude at the time. Had it been higher in the sky, its fifteen faint constituent stars may have been resolved with the same instrument.

Two small open clusters lie near the eastern edge of Puppis, **NGC 2567** being the most enthralling. A 12-inch scope provides a nice view of its fifty magnitude 11 to 14 suns, while smaller backyard instruments show only a few stars against a cloudy glow. **NGC 2571** is a collection of about two dozen 9th-magnitude stars. Their combined light equals a 7th-magnitude star, so the group should be visible in finder scopes.

Moving farther east we cross the border into Pyxis. **Pyxis** the compass is a small, unspectacular constellation along the main stream of the winter Milky Way. Even though it lies along the plane of the Galaxy, its brightest stars are only 4th-magnitude objects. Telescopically, it offers half a dozen deep-sky objects, along with a variable star.

Less than a degree north of Alpha ($\alpha$) Pyxidis is open cluster **NGC 2658**. Look for a small, rich collection of sixty 12th-magnitude stars. The best view is with medium power, but first move

*Larger, brighter, and "looser" than M93 is the open cluster NGC 2477, also in Puppis. NGC 2477 holds 160 stars of magnitude 9.8 and fainter in a circular diameter of 27'. Photo by Martin C. Germano; 8-inch f/10 SCT, 103a-F emulsion, and a 30-minute exposure.*

Alpha out of the field. **NGC 2635** is the same distance away from Beta ($\beta$) Pyxidis. This is a very small gathering of about twenty 12th-magnitude suns. Once again, try medium magnifications and be sure to shift Beta out of the way.

**NGC 2627** is about 1° to the southeast of 5th-magnitude Zeta ($\zeta$) Pyxidis. Depending on the reference you believe, the population of this small open cluster varies from forty to seventy stars. All are gathered into an 8′ area. Incidentally, Zeta is an easy double star for even the smallest telescopes. Its magnitude 5.5 and 10.0 component stars are separated by nearly 1′. Both appear golden yellow and have spectral classifications of G4 and G0, respectively.

**NGC 2613** is a faint edge-on spiral galaxy located north of Eta ($\eta$) Pyxidis, near the triple star $\beta$208 (magnitudes 6, 9, 10.5; separations 0.6″ and 85″). A 6-inch telescope is all you need to show its spindle-like shape at magnitude 10.4. NGC 2613 is easy prey when compared with our next target. **NGC 2888**, northwest of Lambda ($\lambda$) Pyxidis, is a 13th-magnitude elliptical galaxy. There is a 15th-magnitude star superimposed on its southern edge — don't be fooled, you haven't discovered a supernova.

The variable star **T Pyxidis** is an unusual recurring nova, having had five distinct outbursts since 1890. Typically it shines at 14th magnitude, but during an explosion it brightens rapidly to magnitude 6.5 or 7. The last such flare occurred in December 1966. Given its irregular period of about twenty to twenty-two years, we might expect another maximum within the next year or two. A detailed map of it and suitable comparison stars is available from the AAVSO or can be found on page 1523 of the third volume of *Burnham's Celestial Handbook*.

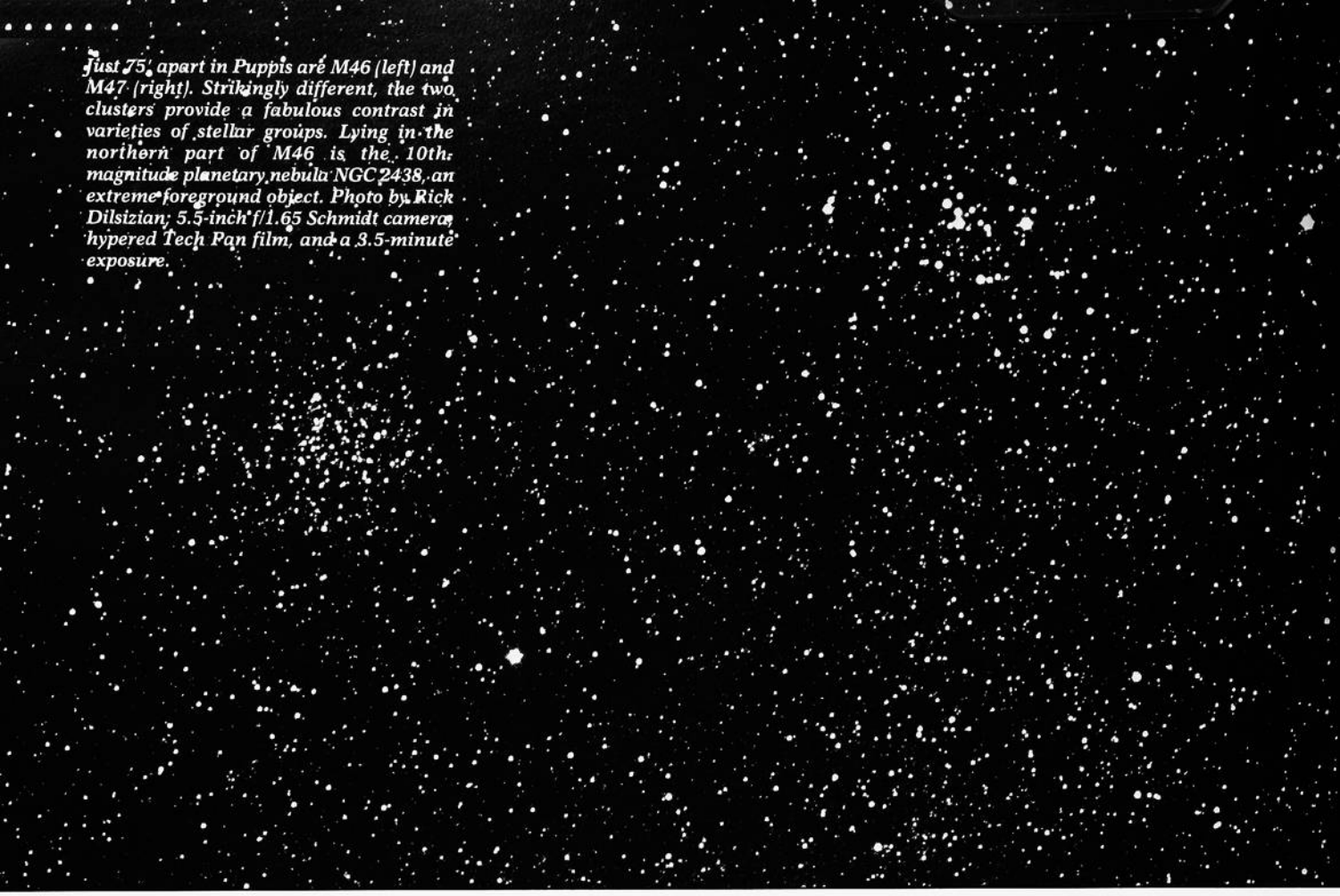
We close our brief stay in Pyxis with the open cluster **NGC 2818**. Initially it would seem to be a fairly uninteresting collection of thirty faint stars. However, by using at least a 10-inch telescope, a 12th-magnitude planetary nebula may be spotted on its western edge. The planetary measures 40″ across and appears as a luminous "barbell."

Bearing due south, we come to the third component of Argo — **Vela**. The brightest star within the constellation is 2nd-magnitude **Gamma ($\gamma$) Velorum**. Binoculars reveal that Gamma is a fine double star, with a magnitude 4.5 companion located 41″ away at p.a. 220°. A third, magnitude 8.5 star may be found 62″ from the primary at p.a. 151°. The primary is especially interesting, because it is an intensely hot Wolf-Rayet star. Although they were once classified in spectral class type O, Wolf-Rayet stars are now separately noted as type W (remember "**W**ow, Oh Be A Fine Girl...") and are known for their high intrinsic luminosity. This star is some 160 parsecs away.

Just north of Gamma Velorum is a beautiful open cluster, **IC 2391**, which can be seen with the unaided eye on a good evening and is easy to spot in finder scopes. My 4¼-inch RFT shows it as a large, coarse gathering of many bright stars, including several doubles. The same instrument should work nicely on **NGC 2669** to the east. NGC 2669 is a small, bright clump of three dozen magnitude 8 and fainter points of light, including the double star **Hussey 1590**.

Farther north lies **NGC 2670**, a 9th-magnitude collection of some twenty faint stars. Locating this object is relatively easy because of a nearby 7th-magnitude star. Another fine cluster is **IC 2395**, which consists of about fifteen bright stars. Their combined light creates a 6th-magnitude glow that is easily visible in binoculars. Only a Moon's diameter separates NGC 2670 and IC 2395 in our sky, so both might just squeeze into the same field of a wide-angle eyepiece.

Near n Velorum is **NGC 2660**. High power is a necessity to get the best view of this small, faint open cluster. It shines at 9th magnitude, its brightest stars shining at only magnitude 12. About



*Just 75' apart in Puppis are M46 (left) and M47 (right). Strikingly different, the two clusters provide a fabulous contrast in varieties of stellar groups. Lying in the northern part of M46 is the 10th-magnitude planetary nebula NGC 2438, an extreme foreground object. Photo by Rick Dilsizian; 5.5-inch f/1.65 Schmidt camera, hypered Tech Pan film, and a 3.5-minute exposure.*

two hundred of them are assembled within a 2′ diameter. **NGC 2659** is an easier target. Its fifty dim stars shine collectively at magnitude 9, appearing as a rich grouping visible in binoculars.

Just west of NGC 2659 is the pulsar **PSR 0833-45**, centered within the **Gum Nebula**, a large and faint supernova remnant named after its Australian discover Colin Gum. The Gum Nebula is far too large to view in its entirety in a telescope, extending over a 35° area through Vela and Puppis. Few visual sightings of any part of the Gum Nebula have ever been published. In this age of high-tech nebula filters, perhaps it is possible to glimpse the nebula's brighter regions. *Deep Sky* will publish any such observations in upcoming issues.

**NGC 2671** is a dim open cluster unfortunately situated in a rich Milky Way field. The brightest of its twenty-five stars shine at a mere 11th magnitude, causing the cluster to get lost in the background. Look for NGC 2671 just north of d Velorum, between 6th- and 7th-magnitude stars.

If you enjoy looking for faint nebulae, try **NGC 2626**. Even with averted vision it appears as nothing more than a shimmer of light surrounding a 10th-magnitude B-type star. Wait for an especially transparent night when atmospheric extinction is at a minimum to get your best view of this object.

Much easier to find is the open cluster **NGC 2547**. It is located south of Lambda (λ) Velorum in a rich Milky Way starfield. The cluster stands out well, with its stars set in a pattern resembling a curved cross. In all about fifty stars belong to this bright cluster, making it a fabulous sight in small scopes.

**NGC 3132** is one of the brightest planetary nebulae in the sky. It is located near the Vela-Antlia border, officially belonging to the constellation **Vela**. NGC 3132 shines conspicuously at 9th magnitude and is comparable in size to the Ring Nebula in Lyra. Its central star is 10th magnitude and is easily seen in a 3-inch telescope. Nicknamed the "Eight-Burst Nebula" because of its complex multi-ring appearance in photographs, NGC 3132 appears pure white in the eyepiece. About 800 parsecs separate the Eight-Burst Nebula from Earth. Find NGC 3132 by scanning 10° east of Psi (ψ) Velorum or by dropping about 52° due south of Regulus.

A fainter planetary is located about one-fourth of the way from Lambda to Psi Velorum. **NGC 2792** is a 12th-magnitude oval disk with an exceedingly faint central star. The nebula's visibility is strongly dependent on an unobstructed, haze-free view to the south.

Open clusters **NGC 2910** and **NGC 2925** form a pair northeast of Kappa (κ) Velorum. Each is catalogued as an 8th-magnitude object with thirty members, but they appear quite different from each other. NGC 2910's stars are tightly gathered in a 6′ diameter, while NGC 2925 is a coarser group spanning 1½′. Backyard telescopes provide a most pleasing view of both. South of Kappa, near Carina's border, is **IC 2488**. This object is a swarm of fifty stars spread across 20′. Although they are dim, the stars are so numerous that they equal a 7th-magnitude star, which makes them visible in binoculars.

**NGC 3228**, in eastern Vela, is a bright open cluster. About two dozen stars of 9th magnitude and fainter are loosely compressed into a 20′ diameter. The group has an integrated magnitude of 6.0, so it can be easily found halfway between Theta (θ) and Mu (μ) Velorum.

A lone globular cluster lies within Vela. Seventh-magnitude **NGC 3201** is an extremely loose assemblage of stars that is partially resolvable in 6- to 8-inch telescopes operating at low power. Larger instruments show individual 13th-magnitude beacons of light across the entire face of this star cluster.

Vela also contains three faint galaxies. **NGC 3256** is a 12th-magnitude peculiar

*Another pair of deep-sky objects is the open cluster NGC 2453 and the planetary nebula NGC 2452, separated by a scant 15'. The cluster contains 30 stars in an area 5' across, combining for a total magnitude of 8.3. The nebula spans only 20" and dimly glows at photographic magnitude 12.6. Photo by Martin C. Germano; 8-inch f/10 SCT, 103a-F emulsion, and a 25-minute exposure.*

galaxy. When searching for it, look for a small, nearly round object with two distinct brighter patches near its center. NGC 3256's appearance has led many astronomers to conclude that it is actually two colliding galaxies. Just to the south is **NGC 3261**, which appears as a 13th-magnitude oval glow with no hint of a central brightening. Finally, **NGC 3318** is a magnitude 12.5 barred spiral with a bright nucleus. All three are difficult to see with anything less than an 8- or 10-inch instrument.

Next we come to **Carina** the keel. Carina is the southernmost component of Argo Navis and is only partially visible from the lowest latitudes of the United States. Carina is marked by brilliant **Canopus**, the second brightest star in the night sky. Canopus, an F0 giant, shines at magnitude −0.72 and is normally only considered a far-southern target. Yet it is visible from as far north as Washington, D.C., given a clear horizon to the south. I saw Canopus for the first time last April from Everglades National Park in Florida (latitude 25°N). It appeared as a sparkling white jewel casting a reflection in the calm water of Florida Bay.

**NGC 2516** is a striking open cluster in western Carina spanning 1°. It is easily visible to the naked eye as a hazy patch between Alpha Pictoris and Epsilon Carinae. Some of its one hundred stars are resolvable with 7x50 binoculars; a rich-field telescope offers a dazzling view. There is a lone ruddy member toward the cluster's center and the other stars shine pure white. NGC 2516 spans 5 parsecs and is about 370 parsecs from Earth.

**NGC 2808** is a fine globular cluster located about 4° west of Nu (ν) Carinae. Its many 13th- to 15th-magnitude stars combine to produce a 6th-magnitude glow that may be glimpsed with the naked eye on a dark, transparent night. Resolving the cluster is difficult, though, because of its high star density.

Carina contains half a dozen planetary nebulae within reach of backyard telescopes. The easiest to identify is 10th-magnitude **NGC 2867**, lying just north of Iota (ι) Carinae. Low magnification yields a stellar image, but its 12"-diameter disk becomes more apparent as power is increased. **IC 2621** is less than a magnitude fainter, but its 2"-diameter disk makes identification a difficult task. **IC 2448** and **NGC 3211** are both 12th-magnitude planetaries with disks measuring 8" and 14", respectively. Each proves challenging in medium and sometimes even large telescopes. The list of Carina planetaries is completed with 11th-magnitude **IC 2501** and 13th-magnitude **IC 2553**. The former is southeast of Iota Carinae, while the latter is just 1¾° west of NGC 3211. Both 2501 and 2553 appear stellar in all but the largest amateur telescopes.

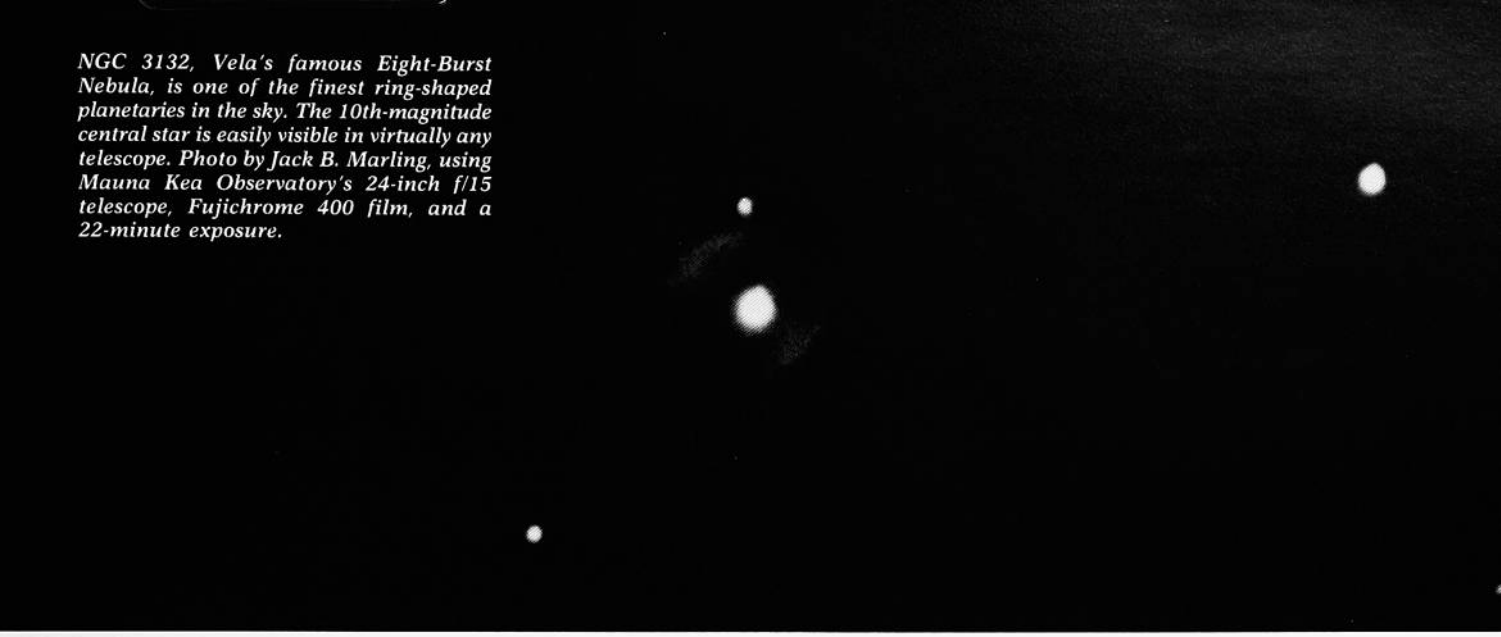
**NGC 3114** is an attractive open cluster within the visibility range of most binoculars, although it just barely skims the southern horizon from the United States. My 4¼-inch f/4 RFT is only able to show eight magnitude 7 to 9 stars, but there was some haze on the horizon that night. Under better conditions about one hundred stars down to 13th magnitude can be seen within its ¾° diameter.

Farther southeast, surrounding 3rd-magnitude Theta (θ) Carinae, is **IC 2602**, the "southern Pleiades." Some thirty 5th-magnitude and fainter stars reside in this cluster, scattered across more than 1°. Binoculars are your best bet for seeing the bright central star with its attendant ring of shimmering white suns. At a distance of 230 parsecs, IC 2602 is one of the closest open clusters to us.

Open cluster **Melotte 101** is superimposed on the southern edge of IC 2602. This is a small gathering of about forty faint stars that is easily overlooked because of the dazzle of its larger neighbor. Melotte 101 lies adjacent to a 6th-magnitude star to the west, which aids in locating the group.

Carina is well known for its spectacular Milky Way starfields, yet there is

*The Eta (η) Carinae Nebula photographed by David Healy from Arequipa, Peru. Healy used an 8-inch f/1.5 Schmidt camera, hypersensitized Tech Pan film, and a 25-minute exposure with a #92 red filter.*



*NGC 3132, Vela's famous Eight-Burst Nebula, is one of the finest ring-shaped planetaries in the sky. The 10th-magnitude central star is easily visible in virtually any telescope. Photo by Jack B. Marling, using Mauna Kea Observatory's 24-inch f/15 telescope, Fujichrome 400 film, and a 22-minute exposure.*

a pair of galaxies within the constellation that may be glimpsed with backyard instruments. **NGC 3059** is the brighter of the two and lies in the far southern part of the constellation near Carina's border with Chamaeleon. This barred spiral shines at magnitude 12.2 and measures 3′ x 2.5′. The other galaxy in Carina is **NGC 3136**, about 4° southwest of IC 2602. It glows dimly at magnitude 12.4 and is an elliptical.

Due north of IC 2602 is one of the most spectacular objects in the entire sky. NGC 3372, better known as the **Eta Carina Nebula**, is a huge glowing cloud measuring over 1° across. Dark rifts divide the nebula into several distinct regions; many stars are embedded within. The dark cloud superimposed across the bright central portion of the nebula is NGC 3324, the **Keyhole Nebula**.

The larger teardrop-shaped nebulous patch contains **Eta** ($\eta$) **Carinae** itself, some 1200 parsecs from Earth. This remarkable nova-like star was first noted by Edmond Halley in 1677. At that time he estimated its brightness to be 4th magnitude. By 1730 the star's magnitude had increased to 2nd magnitude, but it then fell back to 4th over the next fifty years. It continued to fluctuate until April 1843, when it reached magnitude −0.8, slightly brighter than Canopus. Since that time it has continued to vary, but never with as great an amplitude. The star currently shines at 6th magnitude. Eta Carinae's spectrum shows it to be about a 10 $M_{\odot}$ star, with large amounts of some heavy elements. These facts have led many astronomers to conclude that Eta Carinae is a leading candidate to be the Milky Way's next supernova.

As seen from the Everglades, NGC 3372 never rises more than a little over 5° above the horizon. Still, it was easy to spot with the naked eye and bright in a 6x30 finder. My RFT, armed with a 26mm Plossl eyepiece and nebula filter, revealed complex, subtle rifts and details, even at low altitude. From the Cape of Good Hope, Sir John Herschel was awed by "the beauty and sublimity of the spectacle offered by this nebula, when viewed with a sweep, ushered in . . . by a glorious and innumerable procession of stars, to which it forms a sort of climax."

The Eta Carinae Nebula is situated in the brightest portion of the Milky Way as seen from Earth. Surrounding it are numerous open clusters and islands of nebulosity. Slightly farther north is **NGC 3293**, a bright open cluster. About fifty stars (one red M supergiant among blue luminaries) from magnitude 6 to 13 highlight this striking group. At a distance of 450 parsecs, the cluster is not physically associated with the Eta Carinae Nebula but is a foreground object.

**IC 2581** is easily found surrounding 5th-magnitude P Carinae. Its three dozen stellar citizens may be resolved in a 4-inch scope and offer a lovely scene in low power. **NGC 3199** is a smudge of bright nebulosity just to the west. A 6-inch instrument should show it, although a nebula filter may be needed for positive identification.

There are so many superb clusters within Carina that determining which one is "best" is an all-but-impossible task. None of them can be considered "dull" or unworthy of attention.

However, **NGC 3532**, a naked-eye object, is something special. Herschel wrote that this was the most brilliant cluster he had ever seen. E. J. Hartung, in his book *Astronomical Objects for Southern Telescopes*, describes NGC 3532 as a "magnificent cluster [with] numerous bright, scattered stars." About four hundred stars populate NGC 3532, and 150 of them range from 6th to 12th magnitude.

Shifting about 2° south of Eta Carinae will place you in a region of faint nebulae and star clusters. **NGC 3572** is a small but bright open cluster. The brightest of its forty stars is a 7th-magnitude object. Telescopes with smaller than 10 inches of aperture show the faint nebulous glow of unresolved stars surrounding brighter star images. Although it covers only 6′, this coarse group is best suited for low-power searching.

Less than a degree away is **NGC 3590**, another open cluster. Its brightest stars are 9th-magnitude objects, which are packed tightly into a 4′ diameter. Try medium magnifications for the best view.

Just south of NGC 3590 is a swarm of dim nebulous patches, the brightest of which is **NGC 3581-82**. Search for a small shapeless glow. (Wait for an ideal sky before attempting this one.) Other, even fainter nebulae in the immediate area include: **NGC 3576**, **NGC 3579**, **NGC 3584**, and **NGC 3586**. All require the best conditions and premium optics for detection.

If you have an equatorially-mounted telescope, center on 2nd-magnitude Lambda Centauri and then shift westward about 2° to find **IC 2714**. This little observed, rich open cluster is home to about 150 faint stars.

The old ship *Argo Navis* no longer dominates the late winter southern sky, but left in the ship's wake is a fascinating selection of some of the most dramatic and elegant deep-sky objects. Pay a visit to as many of these as you can while on your winter's journey. Be sure to drop us a line — we just love to get picture postcards at the office. Bon voyage!

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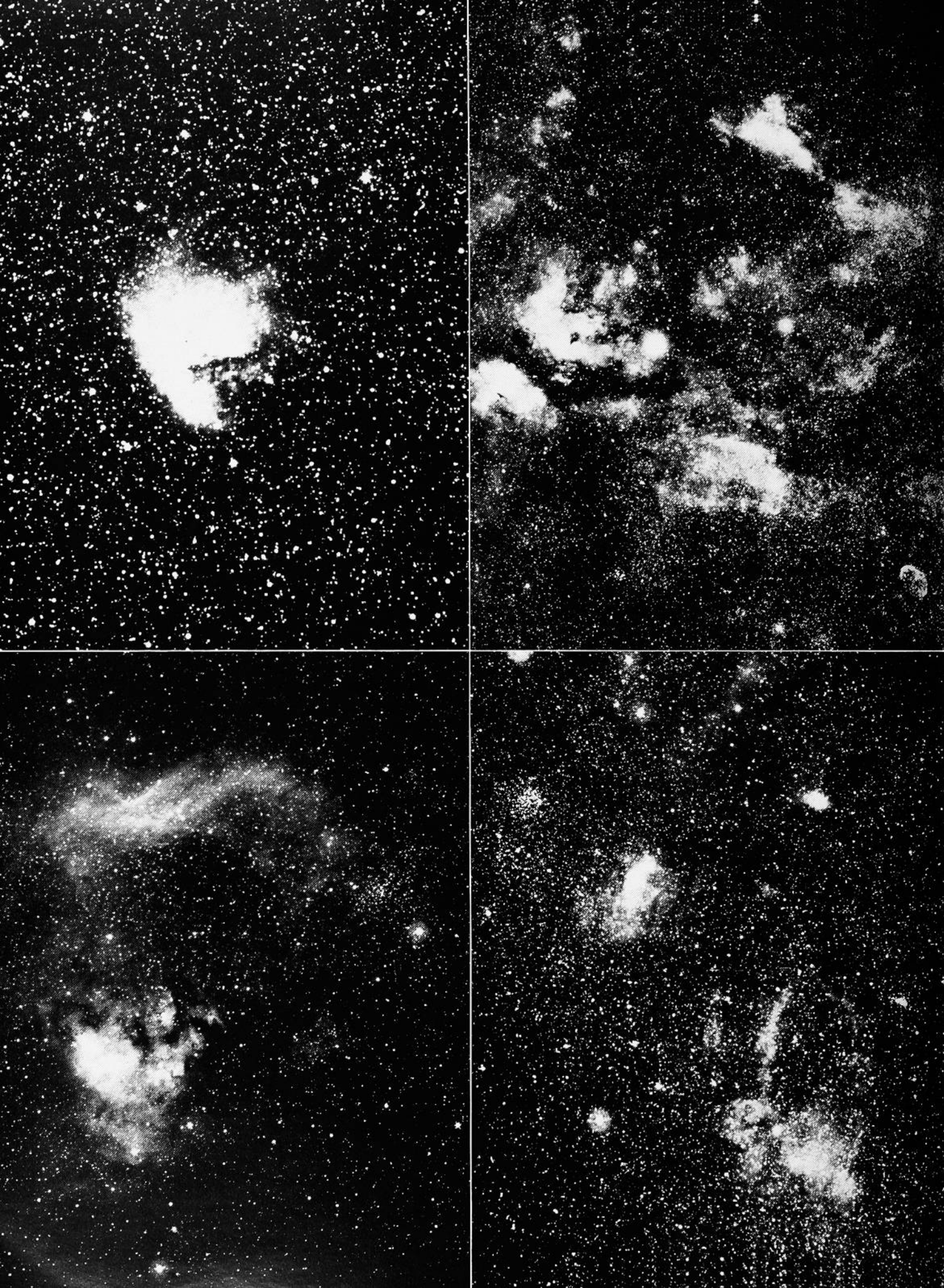
*Phil Harrington is an experienced deep-sky observer living in New York, and a frequent contributor to* Deep Sky.



# Photographing the Northern Milky Way

by Robert Reeves

Living in a large city can be a frustrating experience for an astrophotographer. From my house in San Antonio, Texas, light pollution limits the exposure time of even a deeply-filtered photograph to six minutes.

With only six minutes to collect light, the rule of thumb is that if I cannot see an object in the finder scope, the camera will not record it before sky fog stops the exposure. Many bright objects are well within the range of being photographed, however, and I've recorded them all on film. I am past the point of being able to shoot new objects at will.

To reach into deeper space and photograph nebulae invisible to the eye, I had to move my astrophotographic rig outside of town. Luckily, a good friend of mine allows me to use his observatory, which is located some 25 miles north of San Antonio.

Once I relocated, however, I still wasn't in perfect shape. San Antonio is a city of 1 million people who have an almost fanatical love for mercury and sodium vapor street lamps. Although I'm 25 miles north of center city, the thousands of lights in San Antonio make such a bright glow to the south that the city looks like it's burning! This makes the southern sky, with all of its grand clusters and nebulae, unreachable. So I've discovered the photographic marvels of the northern sky.

Most observers don't realize that, though they're quite faint to the eye, many nebulae in the northern sky are giants in comparison to popular southern targets like the Lagoon and Omega nebulae. In the south, Sagittarius is famed for its many star clusters and rich areas of nebulosity, but Cassiopeia in the north contains just as many of both.

The concept of photographing an object you can't see may be unsettling, especially to beginning astrophotographers. Don't let it bother you one bit. With good star charts and a little star hopping practice you can easily place the spots where large nebulosities lie right in the center of 135mm or 200mm telephoto lens fields.

The photographs on these pages illustrate some of the finest northern nebulae and star clusters. They were all made with a 300mm focal length astrocamera. Except for the Pleiades photo, all are 30-minute exposures made with a Wratten #92 red filter and hypersensitized Tech Pan film. The Pleiades shot is a 4-minute exposure on 103a-O emulsion.

Page through this gallery of the northern sky's celestial treats. Remember that with proper planning, charts, and star hopping, these little-known nebulosities can be discovered by amateur astrophotographers. All you have to do is point your camera in the right direction and see what develops!

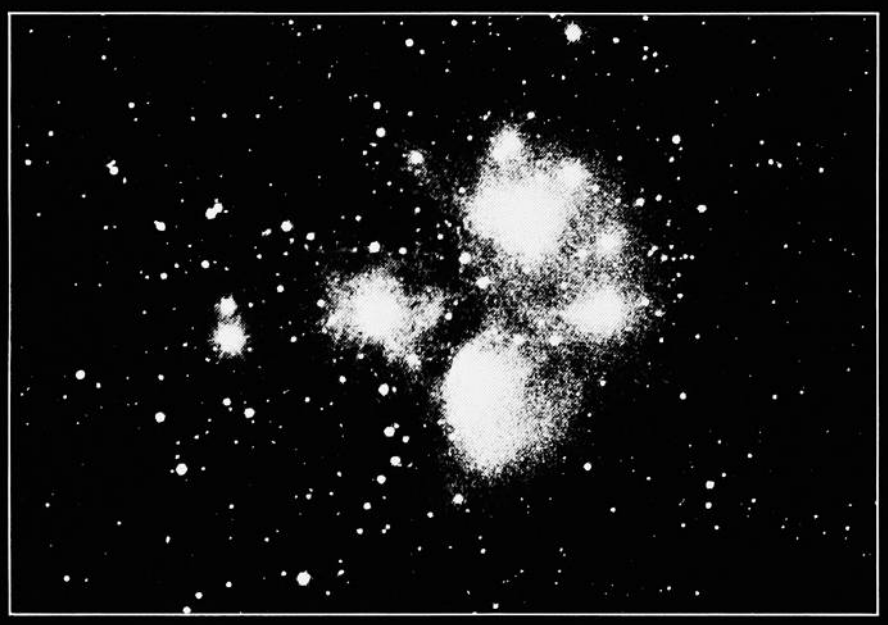
*Top left: NGC 281 in Cassiopeia is a challenging target for small telescopes.*

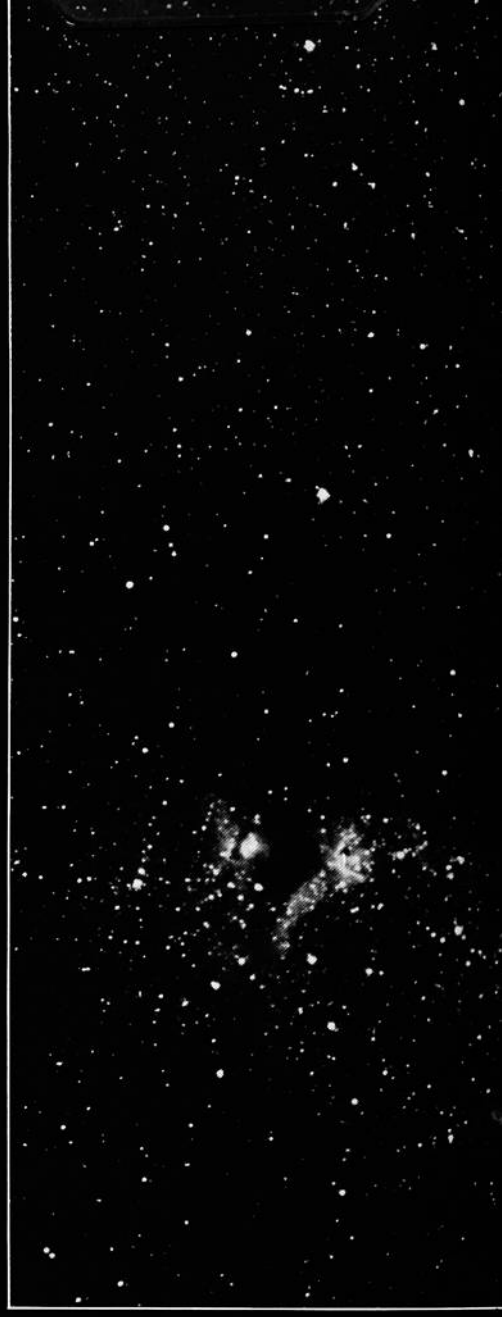
*Top right: The complex, nebulosity-ringed region of Gamma Cygni appears like an abstract Rorschach blot.*

*Bottom left: Large and wavy, emission nebula NGC 7822 in Cepheus floats gracefully above the brighter patches Lynds 118.51 and 118.28.*

*Bottom right: Bright cluster M52 (upper left) is dwarfed by extensive filaments of nebulosity in northern Cassiopeia. The Bubble Nebula lies above and slightly left of center.*

*Robert Reeves is an experienced astrophotographer and telescope maker living in San Antonio, Texas. He has contributed several articles to* ASTRONOMY *magazine in the past.*





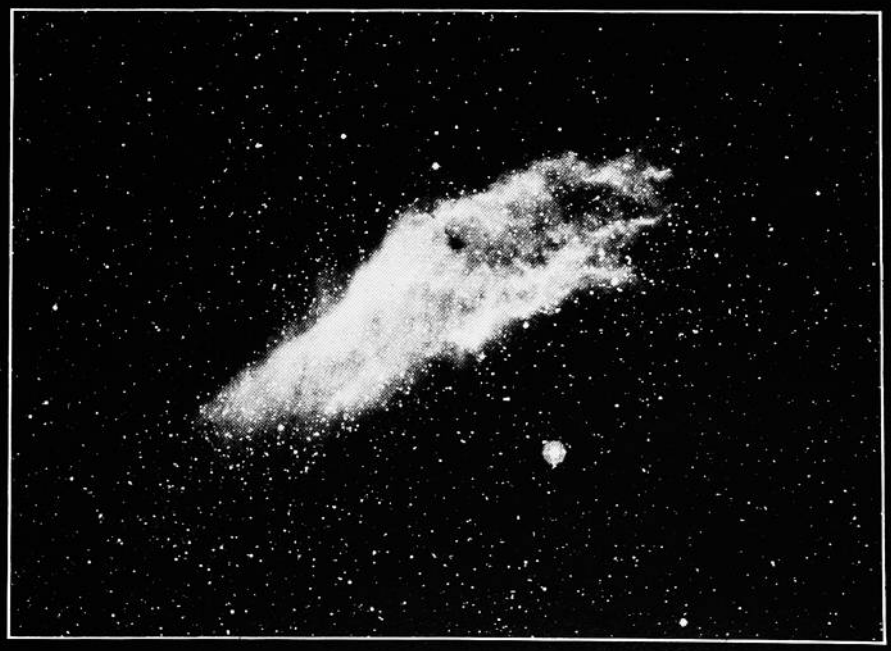
*Top left: The Double Cluster in Perseus offers two of the sky's greatest open clusters separated by slightly more than a Moon's diameter.*

*Left center: The Pleiades cluster in Taurus is one of the prettiest naked-eye sights in the sky. Around it lies an extensive albeit very faint network of tenuous reflection nebulosity.*

*Bottom left: Faint emission and reflection nebulosity winds its way around central Auriga, masking a handful of star clusters.*

*Above: Although very faint to the eye, the sprawling nebulae IC 1805 and IC 1848 in Cassiopeia are dramatic subjects to the camera. Each is filled with subtle detail and packed with bright stars. Eight millimeters from the bottom of the frame and 102 from the right-hand edge of the paper is the tiny, heavily obscured galaxy Maffei 1.*

*Right: The quintessential challenge to small RFTs and binoculars under a dark sky is the California Nebula in Perseus.*



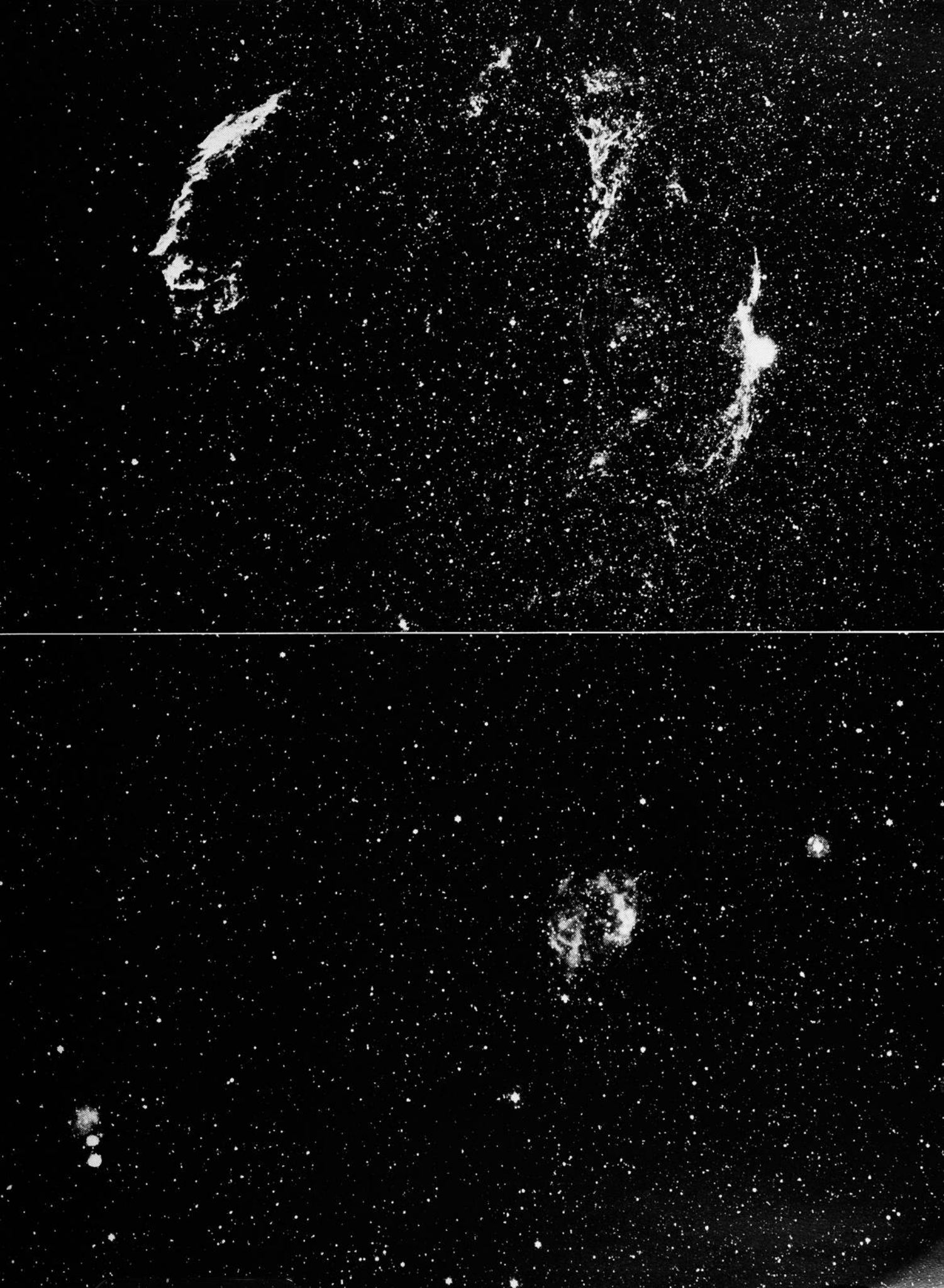
*A cut from the richest section of the northern Milky Way: Four photographs composited into a montage show the region of the North America Nebula near Deneb. An amazingly detailed series of dark nebulae cut across this immense cloud of gas, providing one of the finest spots in the sky for backyard astrophotographers.*

*Above: Lying within a rich star-studded field in Vulpecula, this small star cluster, NGC 6823, is surrounded by a misty cloud of emission nebulosity designated NGC 6820.*

*Top right: The Veil Nebula in Cygnus, NGC 6960 (right), NGC 6979 (center), and NGC 6992, NGC 6993, NGC 6994, and NGC 6995 (left) offer rich detail to backyard astrophotographers.*

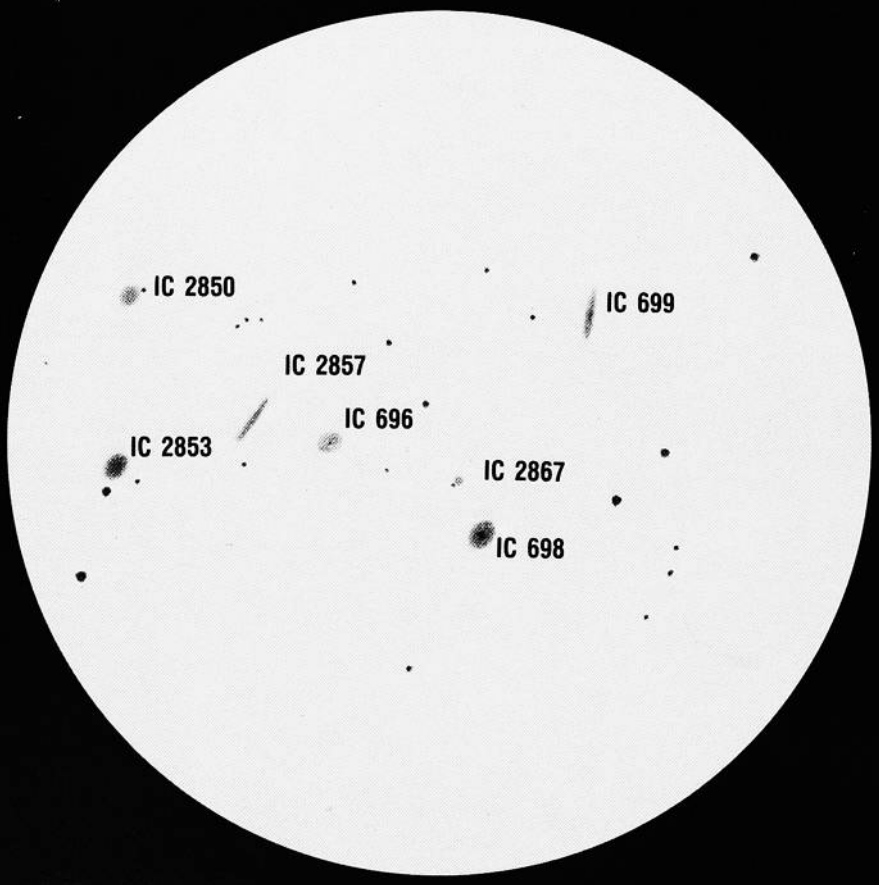
*Right: Although not a part of the Milky Way, pinwheel galaxy M33 in Triangulum is one of the finest galaxies in the northern sky and offers a perspective on our Galaxy viewed from afar.*

*Far right: Measuring some 30′ across, the neglected emission nebula Sharpless 2-261 in northern Orion overshadows its smaller neighbor IC 2126 (left).*



# The IC 698 Galaxy Group

by Jeffrey Corder




*The IC 698 galaxy group is a small system of six faint spiral galaxies that is a part of the Coma/Abell 1367 supercluster. IC 2867 is included here as a possible member of this group, though the evidence is not certain. This sketch is by Jeffrey A. Corder, who used a 17.5-inch f/4.5 Newtonian at 100x and 155. The photographs of individual galaxies were made by B. A. Williams using Lowell Observatory's 1.8-meter telescope, a Carnegie image tube, and a +BG 18 filter. Each plate was exposed for 20 minutes.*

Spotting distant galaxy groups and clusters is the last frontier for enthusiastic deep-sky observers. After the thrill and challenge of annual Messier marathons and nightly sightseeing tours of the sky wane, a whole career could be devoted to studying just one portion of the vast number of galaxy groups and clusters arrayed across the celestial sphere.

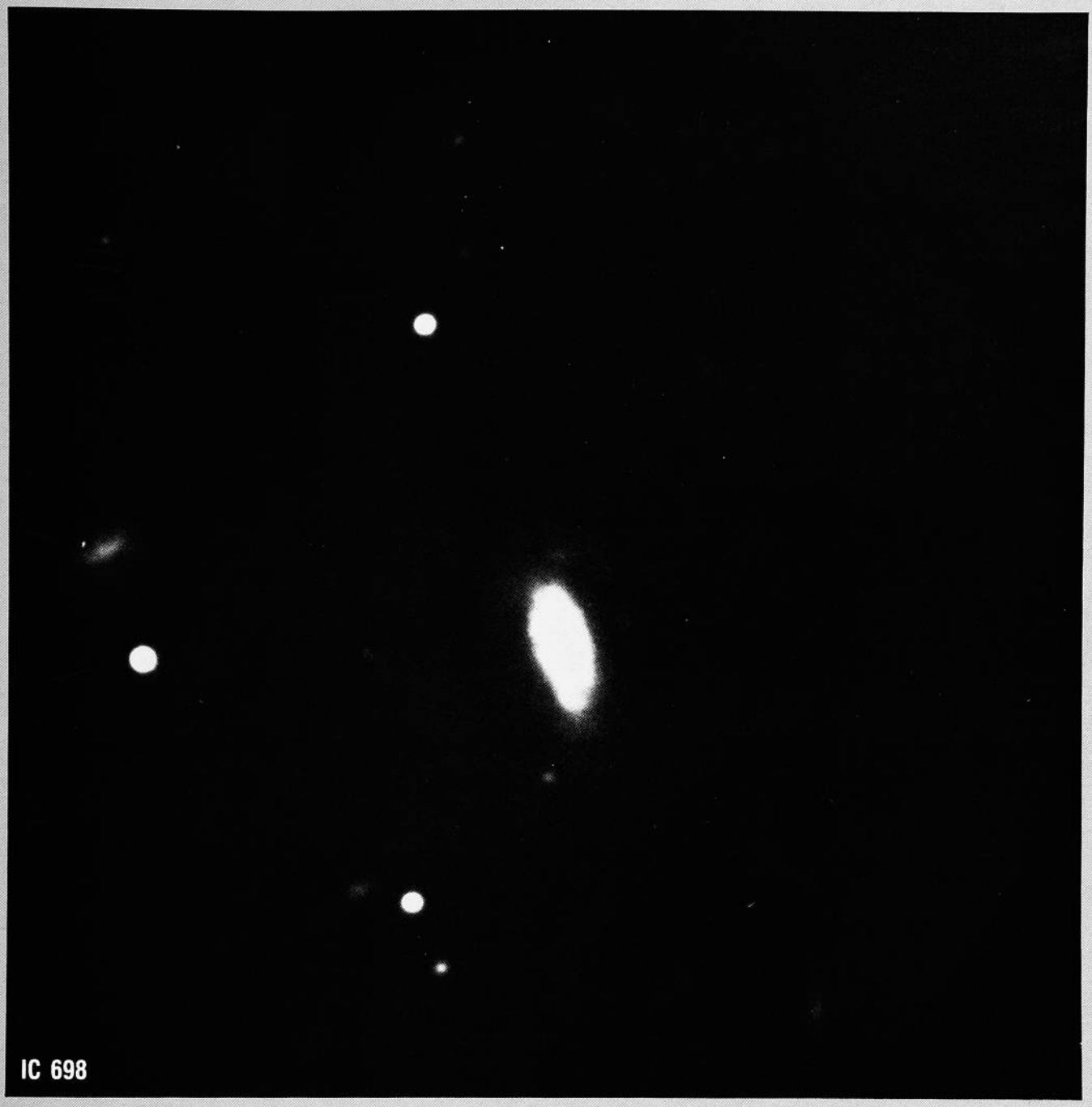
One of these interesting groups is found in Leo: the **IC 698 galaxy group**, a part of the popular and well-studied Coma/Abell 1367 supercluster. This rather obscure and isolated collection of seven galaxies is located along a far southern extension of the host cluster.

The three brightest members of the group were evidently first detected in the closing decade of the nineteenth century and were entered into the first *Index Catalogue* by Dreyer as IC 696, 698, and 699. The discoverer, Dr. Spitaler, employed a 27-inch refractor and also discovered more than sixty other new galaxies, most in the spring sky.

In 1906 the group was again scrutinized by the German astronomer Max Wolf of the Heidelberg Observatory. He used a 16-inch photographic telescope and catalogued twelve galaxies in the region, although some of his discoveries are dubious.

Through a 17.5-inch reflector with a short focal length the IC 698 galaxy group is a fair challenge. The group can be located by searching 10′ southwest of a line adjoining the two bright galaxies NGC 3692 and NGC 3705. The field is dotted with stars of magnitudes 9 and fainter.

The first galaxy to show up under visual examination will likely be **IC 698**



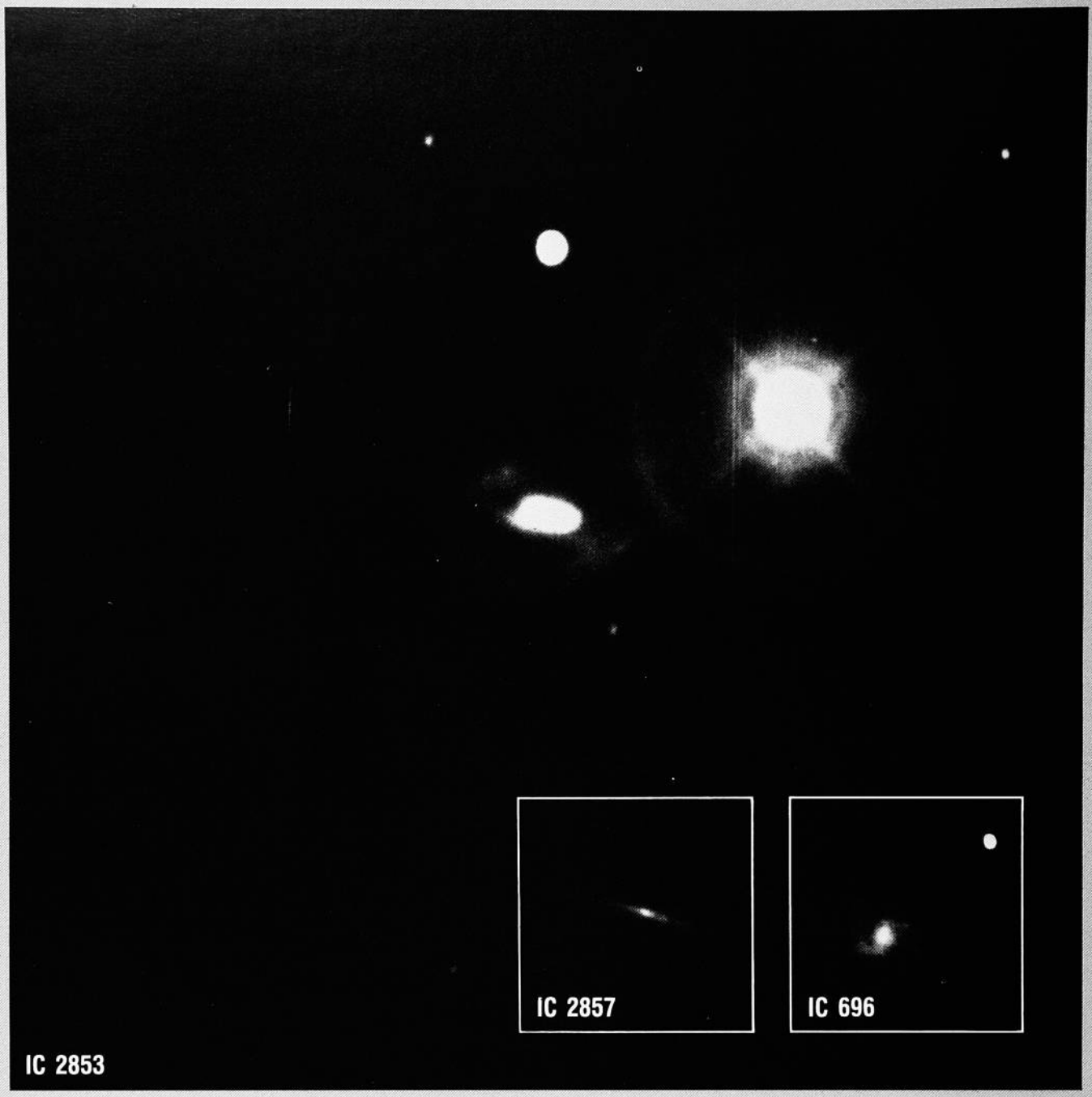

itself. This high surface-brightness spiral is oriented in a northwest to southeast direction and shines at magnitude 14.4. In photographs the galaxy exhibits one spiral arm, although this is impossible to detect visually. In a 17.5-inch telescope IC 698 appears faint, small, and oval in shape. It measures about 50″ by 30″ in size and contains a bright core.

Just over 7′ south lies a second bright galaxy — **IC 699**. This distant barred spiral is intriguing in photographs because the two main arms form a kind of "ring" around the galaxy. Actually, the effect is caused by perspective. Telescopically the galaxy is dominated by its nucleus. It appears very thin and is elongated in a north-south direction. The galaxy is faint at magnitude 14.6 and measures 60″ by 10″.

The faintest galaxy to be seen in the IC 698 group is **IC 2867**, at magnitude 15.6. This extremely faint double system is situated less than 2′ southwest of IC 698. Both components lie to the south of a 15th-magnitude star, although only the brighter, easterly galaxy was noted visually — and then just barely — in conjunction with the very faint star. IC 2867 will test any observer's skills.

At the middle of the group lies a third fairly easy galaxy, **IC 696**. This late-type spiral galaxy shows much detail in photographs, being dominated by arm structure consisting of HII regions, knots, and dust lanes — reminiscent of our closer neighbor M101. In a large telescope IC 696 appears rather amorphous with just a hint of a nucleus, as expected in a galaxy of its type.

***The IC 698 Galaxy Group is a faint and difficult target for medium-sized backyard telescopes, but 12-inch and larger instruments show some of its members with relative ease. IC 698 itself (above) glows at magnitude 14.4 and spans 1.0′x 0.5′. The group's largest galaxy is IC 2857, an edge-on spiral whose long dimension measures 1.7′. The smallest member is 16th-magnitude IC 2867.***




## The IC 698 Galaxy Group

| IC | R.A. (2000) Dec. | Type | Size | Mag. | Incl. |
|---|---|---|---|---|---|
| 2850 | 11h 28.2m +9°03′ | pec | 0.5′x 0.2′ | 14.8 | 78° |
| 2853 | 11h 28.3m +9°08′ | SB a-b | 1.0′x 0.4′ | 14.6 | 65° |
| 2857 | 11h 28.5m +9°06′ | Sc | 1.7′x 0.15′ | 15.3 | 89° |
| 696 | 11h 28.6m +9°05′ | Sc | 1.0′x 0.9′ | 14.5 | 26° |
| 2867 | 11h 29.1m +9°04′ | — | — | 15.6 | — |
| 698 | 11h 29.1m +9°06′ | Sb | 1.0′x 0.5′ | 14.4 | 62° |
| 699 | 11h 29.1m +8°59′ | SBO-a | 1.3′x 0.35′ | 14.6 | 79° |

IC 699

IC 2850

Shining at magnitude 14.5, the galaxy is quite faint, very small, and oval. It measures about 50″ by 30″ and is oriented along a northwest to southeast axis.

Also found near the middle of the IC 698 group, 3′ to the west of IC 696, is the edge-on system **IC 2857**. In a 17.5-inch reflector at 100-power this Sc-type galaxy looks like a tiny needle. There seems to be only a general brightening near the center and no significant nucleus. The galaxy measures about 50″ by 5″ and is elongated just west of due north to south. It is not an easy target but it is a memorable one.

Situated next to a 9th-magnitude star at the northwest corner of the group is 14.6-magnitude **IC 2853**. This barred spiral shows an image in photographs that has been likened to the prominent southern galaxy NGC 1300. The galaxy contains a bright nucleus along with two thin, knotty spiral arms joined by a bridge. In a telescope IC 2853 seems relatively faint, very small, and elongated exactly north to south. The center and nucleus are apparent, and the galaxy measures some 45″ by 30″ in extent.

The final galaxy in the IC 698 group is the very tiny **IC 2850**, at the western end of the group. The galaxy appears almost round, although in photographs it is definitely out-of-round to the northwest. This peculiar system shines at magnitude 14.8 and is very faint. IC 2850 is nearly superimposed on a 15th-magnitude field star. Imagine the tremendous difference in distance these two objects portray. Yet they seem to be of similar brilliance.

The IC 698 group of galaxies offers the dedicated deep-sky aficianado an opportunity to fine-tune his or her observing skills. Yet this group is only one of a multitude of galaxy groups and clusters that await the ardent amateur astronomer. The majority of these galactic collections have never been observed by humans. Still, these incredibly distant galaxy groups and clusters beckon all astronomers ever onward!

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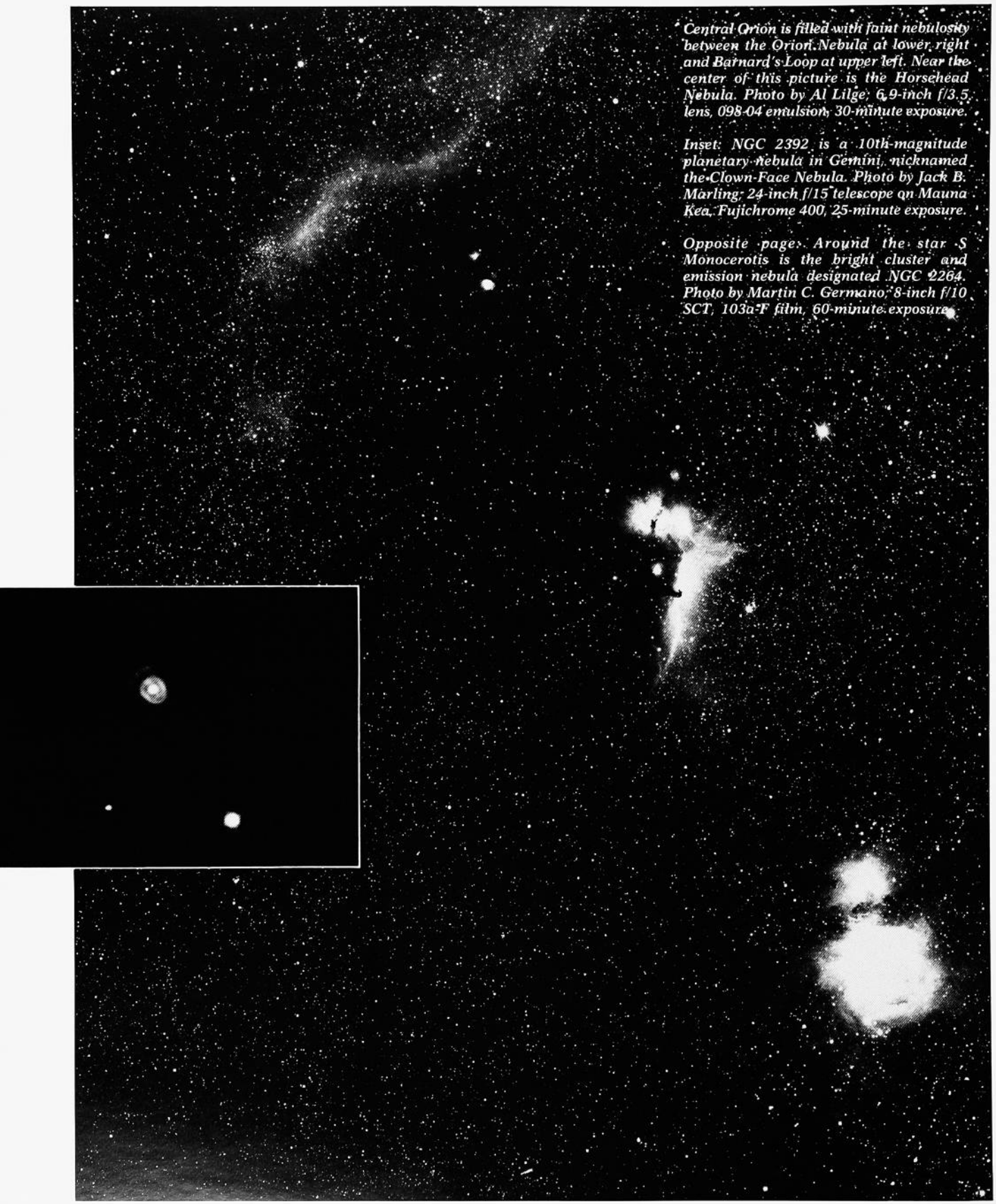
*Jeffrey A. Corder is an active deep-sky observer living near Fort Myers in southern Florida. His last article, "Observing the IC 4329 Cluster of Galaxies", appeared in the spring 1986 issue of* DSM.

# Small Scope Showcase



*Central Orion is filled with faint nebulosity between the Orion Nebula at lower right and Barnard's Loop at upper left. Near the center of this picture is the Horsehead Nebula. Photo by Al Lilge; 6.9-inch f/3.5 lens, 098-04 emulsion, 30-minute exposure.*

*Inset: NGC 2392 is a 10th-magnitude planetary nebula in Gemini, nicknamed the Clown-Face Nebula. Photo by Jack B. Marling; 24-inch f/15 telescope on Mauna Kea, Fujichrome 400, 25-minute exposure.*

*Opposite page: Around the star S Monocerotis is the bright cluster and emission nebula designated NGC 2264. Photo by Martin C. Germano; 8-inch f/10 SCT, 103a-F film, 60-minute exposure.*

# Letting the Sky Call the Shots

**by David H. Levy**

Who decides your agenda for each night's observing? Do you open your telescope, search specifically for M42, and then study its shape and composition?

Most observers do just this, following a process I call *the star-party protocol*. You know, the kind of star party where carloads of people arrive at an observing site, telescopes a-tumbling out of cars, and where each person is all prepared to look skyward. Covers fly off, eyepieces slip in, and then you hear a rallying cry: "Let's all look at M42!"

"All right," the sky replies, "if you want to see the Orion Nebula, and you can find it, I'll show it to you."

Then, as the queue thins out, you holler for a second choice. "M31!" the observers shout and once again the sky obliges.

The philosophy of directed, unspontaneous observing is common to all star parties, amateurs working alone, and professional researchers with large telescopes. Although its efficiency has been proved over centuries, this is *not* the only way to go about sky gazing. Why not reverse the process once in a while and let the sky decide what it wants to show you?

As each session begins I look over a wide area of sky through which I will patrol. Although my ultimate goal is to find comets, I look forward to anything the sky might offer.

I think to myself: "I don't know what you plan to show me tonight — a nebula, a very red star, a low surface brightness galaxy, or a comet. But whatever you offer, I want to see it."

Then I position the telescope to the first field of view I plan to examine, remove the lens covers, and focus. As I am about to start I look away from the eyepiece and back at the sky. With steadily declining light and emerging stars the sky has been preparing itself for me just as I have been readying my telescope for it. No matter what I see, tonight will be a night for discovery. With a final gaze toward heaven I say, "It's your game, sky, go ahead. Make my night."

This way you'll find things you never dreamed existed. Moreover, it has ample historical precedent. How else do you think the Herschels uncovered so many deep-sky objects? Or Otto Struve found his many double stars? Don't let anyone tell you serendipitous searching is unscientific or — horrors! — *unsystematic*. Rubbish! Fun in sky gazing comes wherever you find it.

For example, you might begin with **NGC 1999**, a small emission and reflection nebula just east of M42 (the Orion Nebula) and almost always ignored. Simply by moving your telescope away from the Orion Nebula you open your telescope's eye to the possible discovery of these nearby objects. Certainly not remarkable for its shape, NGC 1999 is interesting because of its anonymity, despite its closeness to the Great Nebula.

If you sweep westward you may (or may not!) encounter some galaxies. Yes, there are actually galaxies in this region whose light reaches us through many light-years of dust along the Milky Way. Some are diffuse, others more condensed, but all require considerable aperture (at least an 8-inch under a good sky) to see. Your star atlas will tell you whether the fuzzy you have spotted is NGC 1726, 1700, 1667, 1659, 1638, 1637, 1625, or 1600. Or, if your telescope is large enough, you may even identify each fuzzy by its shape, the bilateral symmetry of a spiral galaxy or the round and mottled appearance of a globular cluster. One night in 1983 my sweep turned up something that matched none of these — the new object was Comet P/Crommelin.

In any case, the idea is not to search deliberately for X, Y, or Z, but to travel contentedly through the sky, stopping occasionally to take in its sights.

After you explore the winter sky you'll want to marvel at the **Orion Nebula** (M42). Sixteen hundred light-years away and twenty-five across, M42 is vast. Moreover, there isn't just one Orion Nebula, there are dozens. Each look through a different eyepiece or a different telescope gives a fresh perspective. While low powers emphasize the contrast between the nebula and its surrounding field of stars, a highter power brings out the nebula's exquisite structure.

If we move into Gemini to see **M35**, you may discover its companion, **NGC 2158**. Like M35, this is an open cluster whose individual stars are easily visible through your telescope. This shy cluster hides under the edge of M35, so unless you open your eyes and *look* you may sweep right past it. The Clown-Face nebula, **NGC 2392**, actually looks like the face of a clown, but you need a pretty large telescope to notice that halfway between $\kappa$ and $\lambda$ Geminorum, the nebula's central brightness is surrounded by a faint irregular ring as seen in large instruments.

Perhaps your sky sweep will take you through Monoceros, the Unicorn. If the mythological beast was known for its lovely mysteries, its celestial cousin matches this reputation. First there is the **Rosette Nebula**, NGC 2237-9. The beauty of this nebula is enhanced by its central open cluster, NGC 2244. Use a low-power eyepiece under a dark country sky to enjoy this stunning sight. If your eyes are good you may even spot the open cluster with unaided vision. While you are in the neighborhood, check out NGC 2261, **Hubble's Variable Nebula**, a 10th-magnitude object shaped like a comet tail that surrounds R Monocerotis, a variable star. The nebula actually varies in shape and brightness. Professional astronomers working with large telescopes have noted significant changes over periods as short as six months.

Now, in a token tribute to winter, let's close with a look at NGC 2264, Leland Copeland's famous **Christmas Tree Cluster**. In large binoculars or a small telescope this cluster really looks like its namesake. It is a single cluster whose stars occupy about 20 light-years of space. Around one of the stars is a fabulous dark nebula that stretches like a negative image of a comet tail; the dust cloud is known as the Cone Nebula. This is a region where stars are being born and is stunning in a different way from the similar region of the Orion Nebula. Here, the beauty spreads over many objects.

In a way, I've violated my own principles by telling you what to look at. But I hope you caught my underlying meaning and make some exploratory sky-sweeps of your own, both far from the beaten paths — and also right next to some better-known wonders, too. Discovery is what it's all about, and there's no better time to start than tonight!

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# Plotting the RNGC, Part 3

**by Richard Berry**

On November 12, 1833, forty-year-old John Herschel left England with his wife and young children and set sail for the Cape. His purpose was to complete the survey of the celestial sphere that his father William had begun. He planned to use the same instruments and methods that the elder Herschel had used in surveying the northern sky — meridian sweeps using a large alt-azimuth reflector.

For years the younger Herschel had postponed the trip, revising his father's catalogues of nebulae, starting a family, grinding a new primary mirror for the 20-foot telescope that he would take with him to South Africa, and pursuing his own researches. Finally, when his aged Aunt Caroline Herschel had been visited quite possibly for the final time, and his mother Mary Herschel had died, the inevitable could no longer be postponed, and Herschel sailed for the Cape of Good Hope.

Perhaps the above is slightly unfair. John Herschel spent those years revising and extending William Herschel's survey of the northern sky. John added 525 new objects to the 2,306 in the catalogue, *Observations of nebulae and clusters, made at Slough, with a 20-feet reflector, between the years 1825-1833*. Gunther Buttmann tells the full story of John Herschel's four-and-a-half-year stay at the Cape in his book *The Shadow of the Telescope*, so I will not repeat it here.

Suffice it to say that Herschel undertook his examination of the southern heavens with the same instrument he had used to revise and extend his father's observations of the northern sky: an 18¼-inch f/13.3 speculum metal mirror with a fixed magnification of 180x. John had three mirrors for the 20-foot-long Newtonian telescope because speculum tarnishes so quickly. With three mirrors for the telescope, he could always keep at least one in a reasonably good state of polish.

Herschel surveyed the sky using his father's system of sweeps. As best as I've been able to tell, the telescope would be positioned on the meridian. As the sky drifted past in right ascension, the observer scanned the telescope up and down, through a three-degree range of declination, recording the time (hence the RA) and north polar distance of every cluster, nebula, and binary star, plus a capsule description of the object. Dreyer, in his introduction to the *New General Catalogue*, notes that "large" accidental errors" sometimes occurred in positions obtained from sweeps. Herschel used an equatorial refractor to determine accurate equatorial coordinates for the objects he discovered with the large reflector at the Cape, according to Buttmann. The work yielded a catalogue of 1,707 southern nebulae and clusters, and 2,102 binaries.

Herschel eventually published a book on his researches, *Results of Astronomical Observations Made During the Years 1834, 5, 6, 7, and 8 at the Cape of Good Hope; Being a Completion of a Telescopic Survey of the Whole Surface of the Visible Heavens*. Years later, Herschel collected these southern observations with his own and his father's northern observations in the *Philosophical Transactions* of 1864, producing a list totalling 5,079 nebulae and clusters, the *General Catalogue*. Dreyer's 1888 compilation of the observations of the Herschels and other observers, the *New General Catalogue of Nebulae and Clusters of Stars* is what we now know as the NGC. Sulentic and Tifft's *Revised New General Catalogue*, the RNGC, for which the authors examined every NGC object on the Palomar Observatory Sky Survey and revised positions and identifications of some objects, became the database used to generate the plot of the galaxies of the Southern Hemisphere presented here.

As we saw in Part 1 (DSM, Winter 1985) and 2 (Spring 1986) of this article, the distribution of sky objects is by no means uniform. Note, for example, the prominent "string" of galaxies above M33, and the general trending of bright galaxies running through M77, NGC 1300, the Fornax Cluster, and the Dorado Group. Another broad blob extends from M74 toward NGC 253. Comparing this chart with that of the northern galactic hemisphere, however, we immediately notice the absence of a well-defined supergalactic plane — unless the diffuse arc extending through the Fornax Cluster is its signature.

However, we have missed something. The most prominent feature on this plot is the big empty region near the bottom — a place where very few galaxies are in evidence. It doesn't take careful scrutiny to see that the entire "zone of avoidance" lies south of −40°, the very region that John Herschel charted from the Cape!

This great region devoid of galaxies is not obvious on the equidistant cylindrical projection feature in Part 1, but it is evident enough on close examination. The large number of clusters in the southern loop Milky Way helps to disguise the deficiency of galaxies, as do the bright clusters of objects in the LMC and the SMC. Around 22 hours right ascension, the number of galaxies is more in line with Northern Hemisphere densities in the sky, and this, too, obscures the overall lack of galaxies below −40°.

What could explain this effect? Why did a skilled observer using the same large telescope under the clear skies of the Cape find fewer galaxies than he did from the murky skies of Slough? One can invoke seasonal cloud cover at the Cape, weather, or some other systematic influence on John's galaxy-finding efficiency, but I suspect that the Magellanic Clouds provide a likely explanation. Herschel recognised that these are unique bodies and devoted incredible energy to cataloguing the objects in them. In the SMC he counted forty star clusters and nebulae, while in the LMC he catalogued well over 300 and prepared a chart that Buttmann calls "the best hand-drawn map of the [LMC] ever to have been prepared by an observer directly from his results at the telescope." Herschel also prepared a chart of the Eta Carinae Nebula, measuring and cataloguing the 1217 stars included in it.

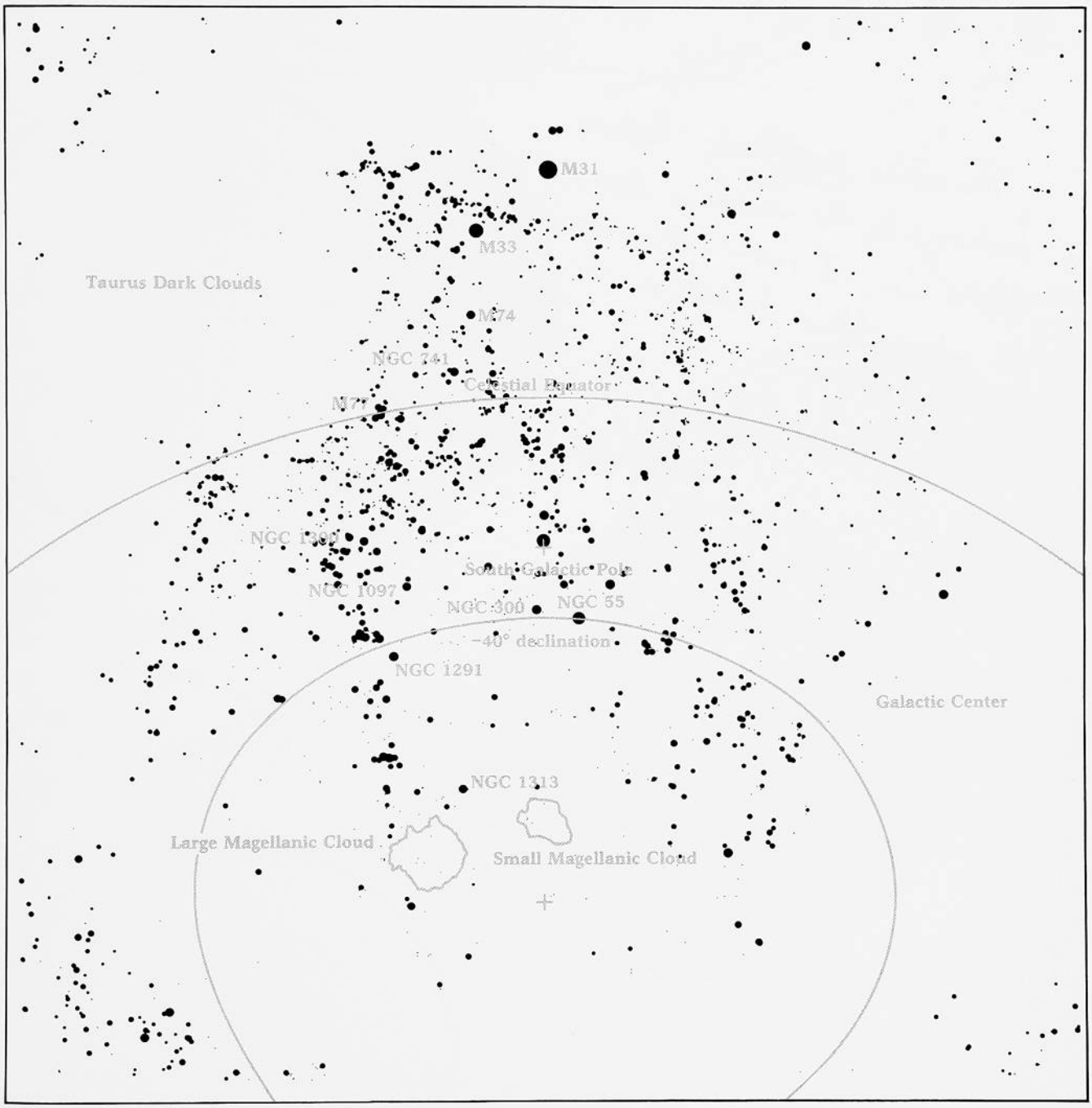
Finally, as if the Clouds of Magellan were not enough distraction, John Herschel made a detailed drawing of the Orion Nebula (at 5h 30m RA). As Buttmann puts it: "Viewing the [Orion] nebula in the clear sky [at the Cape], he realized that there was very much more to the nebula than he had been able to detect through the less favorable atmosphere of England. 'Yet the first glance . . . sufficed to convince me of the necessity of executing a redelineation of it.'"

Where did he get the time for these projects? I suspect that he stole it from his systematic sweeps of the star-poor sky surrounding Nubeculae Major et Minor and the great dim reaches south of Lepus. Who could blame him? Any observer not stirred by the sight of the swirling clouds of the Orion Nebula in a large telescope under clear skies ought to become a theoretician!

The consequences of this fascination are still with us today. *Sky Atlas 2000.0*, for example, draws on the NGC and IC

catalogues for its galaxies — and they are not catalogued. Tirion has thus omitted many hundreds of faint galaxies from his *magnum opus*, and, unless he finds a database that includes the southern galaxies John Herschel missed between 1834 and 1838, these galaxies will be missing from his sky atlases to-be.

One final point deserves airing: what makes me so certain that Herschel's "hole in the sky" is not real? The answer is, of course, that better catalogues have been compiled since the NGC/RNGC, and they show no deficiency of galaxies south of −40°. A recent paper by N. Sharp (*PASP*, vol. 98, p. 740), "The Whole-Sky Distribution of Galaxies," takes considerable pains, at a higher level of sophistication than I have attempted in these three articles, to do for galaxies seriously and rigorously what I've merely touched on in these three articles.



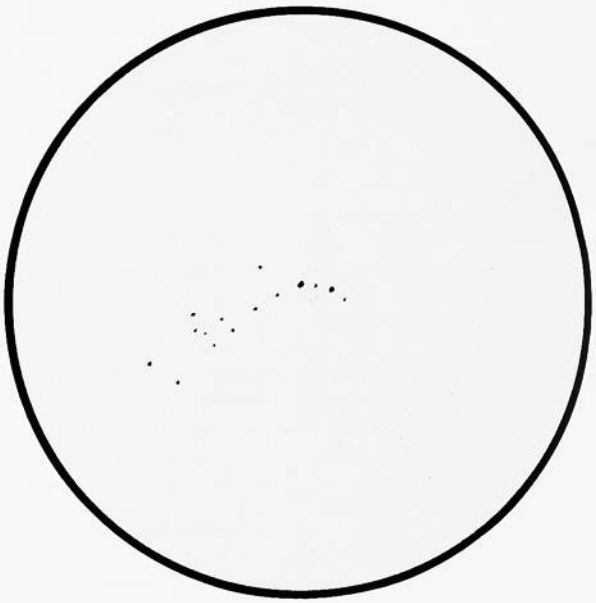

## RNGC Galaxies in the South Galactic Hemisphere

*Seen here plotted on an azimuthal equidistant projection centered on 0h 45m and −27°, the RNGC galaxies south of the galactic equator reveal a markedly non-uniform distribution. The large ring that circles the southern galactic hemisphere is, of course, the Galaxy itself, devoid of galaxies because of obscuring material near the galactic plane. The nucleus reveals itself as a large region of obscuration at the lower right. At the upper left, a region of dark interstellar matter in Taurus blocks galaxies. There is no obvious concentration in the plane of the supergalaxy as we see in the northern galactic himisphere, though an overall "stringiness" is still evident. A conspicuous feature is the low concentration of galaxies south of −40°, except between right ascension 18 to 22 hours. This is apparently an observational effect, possibly due to Herschel's interst in the LMC, SMC, and Orion Nebula. Map by Richard Berry.*

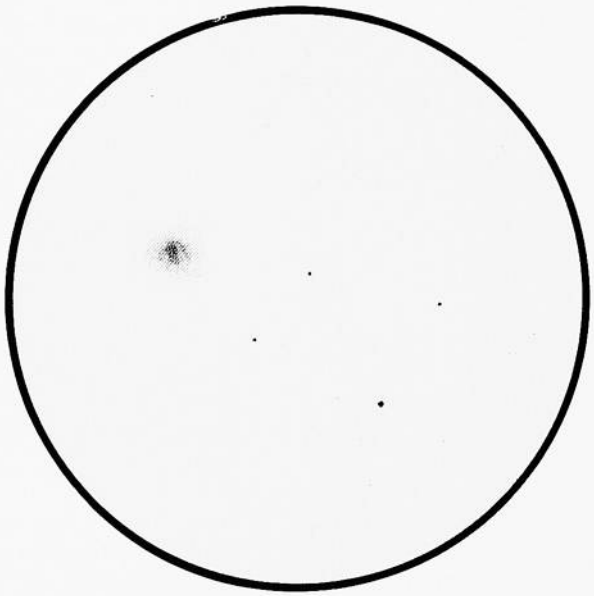
# DEEP SKY SKETC

This issue's sketchbook features renderings by the Canadian observer Alister Ling. I invite others readers to submit their sketches or other scenes.

Yrs truly
D Eilers

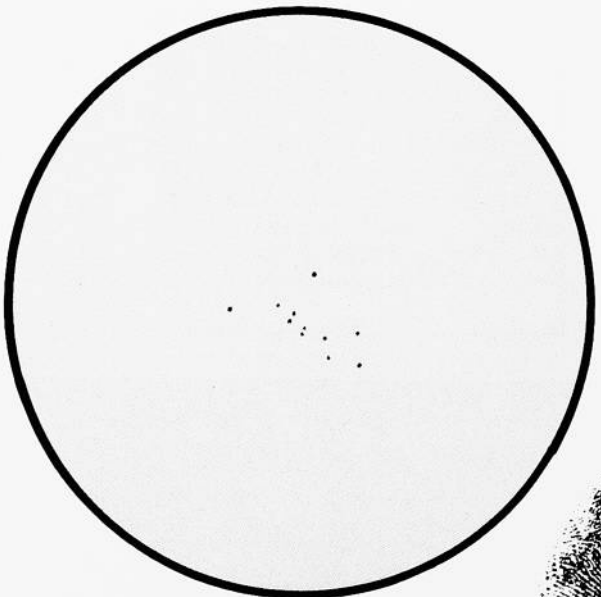


↑ Open cluster NGC 7771 in Cygnus. 255x.
"a curious loop-shaped group of about 15 stars."

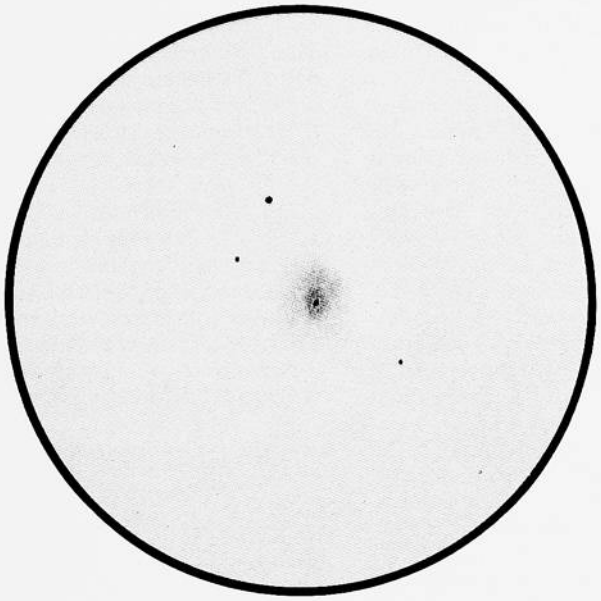


↑ Galaxy NGC 6072 in Lyra. 255x.
"pale, hazy, round with diffuse edges."

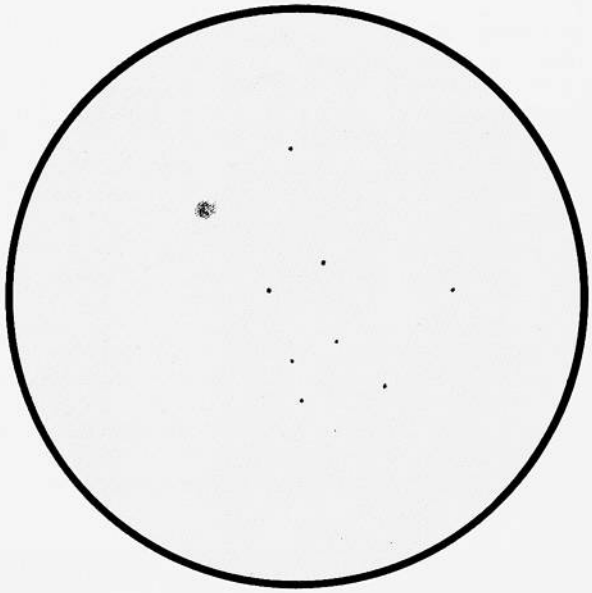
Open cluster NGC 7235 in Cepheus. →
255x.
"not much at high power!"



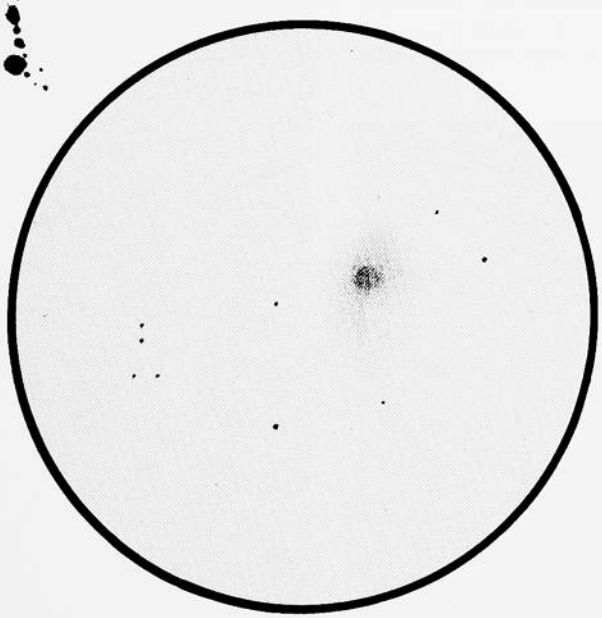
# HBOOK



Galaxy NGC 6710 in Lyra.
255x. "stellar core; outer region elongated in p.a. 150°."



Galaxy NGC 6713 in Lyra.
110x.
"very difficult. cluster in field is distracting."



Galaxy NGC 6615 in Lyra.
113x.
"very difficult. round, has a granular appearance."

all observations made with a 12½-inch f/5.6 Newtonian reflector.

# Double Stars

## Exploring the Unicorn's Belt

**by Glenn F. Chaple**

Orion is the master of the winter sky — an eye-catching constellation that possesses some of the finest telescopic treasures in the heavens. But let's not forget that this wealth spills over into adjacent star groups.

Take Monoceros for example. Recently I scanned through my notes, a copy of *Burnham's Celestial Handbook*, and the Lick catalogue to see what double stars inhabit this overlooked constellation. There are plenty! In fact, I've decided to introduce a very small part of Monoceros — a region in the northwest corner highlighted by a row of three 4th-magnitude stars. Over a dozen good pairs scatter along this rather feeble imitation of Orion's Belt, plus numerous faint or close duos that only the largest scopes could resolve.

The bottom star of the belt is **Epsilon (ε) Monocerotis**, the 900th entry in the Struve catalogue. This striking magnitude 4.5 and 6.5 double is one of the finest in Monoceros. Its 13″ separation assures an easy split by even a 2-inch scope at 30x. The two retain their visual appeal under the scrutiny of larger scopes. Last winter, James Phillips of Charleston, South Carolina, observed this star with an 8-inch f/13 refractor and noted that the primary seemed slightly yellowish, while the lesser star was blue. These impressions mirror those of many who have glimpsed this neat pair. If you own a large scope, look for a 12th-magnitude companion situated 94″ to the west side of the main star.

Two more Struve pairs lie near ε. About one degree to the southeast is **Σ911** (magnitudes 9 and 9; separation 12.5″; position angle 156°; measured in 1942), while a bit further to the northeast is **Σ915** (7.5 and 8.5; 5.9″; 40°; 1933). The former, whose separation is slowly decreasing, is no trouble for small scopes, but Σ915 will require larger apertures, especially if you want to capture the 12th-magnitude companion about 40″ from the main pair.

Just a degree east and slightly south of Σ915 is the open cluster NGC 2244, surrounding the star 12 Monocerotis. The cluster contains several faint double and multiple stars and is wreathed by the faint nebulosity of the Rosette Nebula. Less than a degree north of NGC 2244 is **Σ926**. The component stars shine at magnitudes 7 and 8.5, with an 11.7″ separation that puts them within small-scope grasp.

Another degree north and a bit east of Σ926 is **Argelander 14** (9 and 9.5; 7.0″; 228°; 1926). The separation is no trouble for those with small-aperture telescopes but the faintness of the component stars may pose a problem. Wait for a clear dark night and use a magnification of 100x.

We have now reached the midpoint of the Monoceros "belt" — the star 13 Mon. It isn't double, but its neighbor **14 Mon** (Σ938) is. You'll need a 4-inch scope and high magnification to ferret the 11th-magnitude companion out of the glare of its 6th-magnitude master. Sweep your scope just half a degree north and you'll encounter **Σ930** and **Σ931**. The former is listed as a triple in the Lick catalogue, but I found a fourth member with my 3-inch f/10 reflector. All three companion stars are just over a magnitude fainter than the 8.5-magnitude main star. No more than 100″ eastward is Σ931. The component stars are

| Star | R.A. (2000) | Dec. | Mags. | Sep. | P.A. | Year |
|---|---|---|---|---|---|---|
| ε(=8) | 6h23.8m | +4°36′ | 4.6,6.5 | 13.4″ | 27° | 1937 |
| Σ911 | 6h26.9m | +4°05′ | 9.1,9.1 | 12.5″ | 156° | 1942 |
| Σ915 | 6h28.2m | +5°16′ | 7.6,8.6, | 5.9″ | 40° | 1933 |
| | | | 11.0 | 36.8″ | 126° | 1912 |
| Arg 14 | 6h29.5m | +6°42′ | 9.0,9.3 | 7.0″ | 228° | 1926 |
| Σ926 | 6h31.7m | +5°46′ | 7.1,8.5 | 10.9″ | 288° | 1974 |
| J 264 | 6h34.1m | +8°27′ | 9.5,9.5 | 4.2″ | 81° | 1953 |
| Σ930 | 6h34.1m | +7°59′ | 8.5,9.8, | 26.2″ | 277° | 1919 |
| | | | 9.6 | 43.2″ | 105° | 1919 |
| Σ931 | 6h34.2m | +7°59′ | 10.3,10.5 | 23.5″ | 24° | 1906 |
| 14 (=Σ938) | 6h34.8m | +7°34′ | 6.6,10.7 | 10.5″ | 209° | 1959 |
| Σ951 | 6h40.5m | +9°49′ | 7.9,10.1 | 21.4″ | 310° | 1924 |
| 15 (=Σ950) | 6h41.0m | +9°54′ | 4.8,7.6, | 2.8″ | 213° | 1957 |
| | | | 9.9, | 16.6″ | 13° | 1957 |
| | | | 9.7, | 41.3″ | 308° | 1938 |
| | | | 10.0, | 73.9″ | 139° | 1957 |
| | | | 7.8, | 156.0″ | 222° | 1924 |
| | | | 8.2, | 105.6″ | 56° | 1923 |
| Σ953 | 6h41.2m | +8°59′ | 7.1,7.6 | 7.1″ | 330° | 1932 |
| Σ954 | 6h41.2m | +9°29′ | 7.1,9.6 | 12.8″ | 153° | 1924 |
| Σ952 | 6h41.2m | +9°53′ | 10.2,10.2 | 14.0″ | 115° | 1925 |

*Western Monoceros extends from Gamma Mon — located near southern Orion — to 13 Mon, the star placed between the Rosette and Cone nebulae. Several interesting double stars lie within this area. Photo by David Healy; 28mm f/2.8 lens, hypered Tech Pan film, H[a] filter, 78-minute exposure.*

both about magnitude 10.5, but their 23.5″ separation made them an easy mark for the 3-inch.

A half degree north of Σ930/931 is **Jonckheere 264**. Many of the 3,300-plus pairs uncovered during the early 1900s by this French astronomer require large scopes. A good 4-inch should bridge the 4′ gap that separates these twin 9.5-magnitude stars.

At the top of the "belt" is **15 Monocerotis**. Here is a star that would interest just about any observer. It is slightly variable, part of an open star cluster (NGC 2264), and a close double. The components, of magnitudes 4.8 and 7.6, are just 3″ apart. The magnitude difference makes 15 Mon a test object for small telescopes. It's only natural that a double star located in an open cluster would be attended by oodles of fainter companions. The accompanying data table gives the particulars on some of the main ones.

Two more Struve pairs are in the same field with 15 Mon. **Σ952** (10 and 10; 14.0″; 115°; 1925) is a mere 4′ east of 15, while **Σ951** (8 and 10; 21.4″; 310°; 1924) is about twice that distance to the southwest. But we're not through yet — I told you there were scads of double stars in this region! South of 15 Mon are **Σ954** (7 and 9.5; 12.8″; 153°; 1924) and **Σ953** (7 and 7.5; 7.1″; 330°; 1932). Σ953 is an especially pretty pair and a nice way to wrap things up. Imagine how busy we'd be if we had tackled all of Monoceros! Rest assured that we'll examine another chunk of this constellation at a future time.

* * *

*Double Takes*...In response to all my fussing over the identity of F. Kustner last spring, two readers — Dr. R. H. Garstang of the Joint Institute for Laboratory Astrophysics in Boulder, Colorado, and Marion Hochuli of Nashua, New Hampshire, forwarded some valuable background information. I can now tell you that, among other things, Friedrich Kustner (1856-1936) was director of the Bonn Observatory from 1891 until his retirement in 1926. He produced two star catalogues (which probably led to his double star discoveries), did a great deal of work on stellar radial velocities, and discovered the variability of latitude.

A thank you to Dr. James Philips of Charleston, South Carolina, for sending a nice set of notes on many Orion doubles he observed last winter. Dr. Phillips viewed each pair with an 8-inch f/13 refractor and then rated it on a scale of 1 ("Seen it — no interest in returning") to 5 ("Fabulous! A real show object!"). Among the Orion doubles rated 5 by him were Σ654, DA 5, Σ738, $\theta^1$ (Σ748), and $\sigma$ (Σ762).

The next issue will feature a guest writer in this column. Brian Skiff, who has produced numerous articles for *Deep Sky* in the past, will take the helm while I enjoy a breather. (When everything starts looking double, it's time for a break!) I'll see you again in the Summer 1987 issue. Until then, clear skies.

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# Variable Stars

## The Pleasures of a Night on the Town

**by David H. Levy**

Why do people observe variable stars? What makes otherwise normal people forego the pleasure of a night on the town and attracts them to a single point of light that appears so normal that it could easily be confused with other stars?

When variable star observing became popular in the early years of this century, the prospect of amateur observers adding something to our understanding of nature was the main attraction. In his hugely popular *Field Book of the Skies*, William Tyler Olcott invited readers to become part of "the great work of astrophysical research" through a program that could be accomplished from their own backyards. In those early years the ranks of amateur variable star observers were so thin, and their contributions so appreciated by the Harvard College Observatory, that director Harlow Shapley actually sent a thank-you note to acknowledge each observer's report!

The winds of stellar research now blow in a different direction. Where the careful monitoring of hundreds of long-period variable stars once lay on the cutting edge, it no longer does. In 1920 few astronomers even knew about dwarf novae, an important research field today. Astronomy is dynamic and evolving, and amateurs who wish to contribute must follow the trends.

All this, however, does not explain the observed fact that the long period Mira stars still command a lot of amateur interest and thus it seems that making a contribution to science is no longer the only attraction that variables offer.

Why *do* people observe variable stars? I think that the real answer lies in the variables themselves. These innocuous objects attract our interest because their delights lie in their behavior, not in their appearance. Although they do not look fascinating at first glance, consistent watching rewards the patient observer.

In this winter season we begin with an old friend, 074922 **U Geminorum**. This is an explosive star of a type we have encountered often in this column. Its eruptions are not very predictable and nightly monitoring often yields surprises. U Gem works on its own hours and you need to be alert to catch it in outburst.

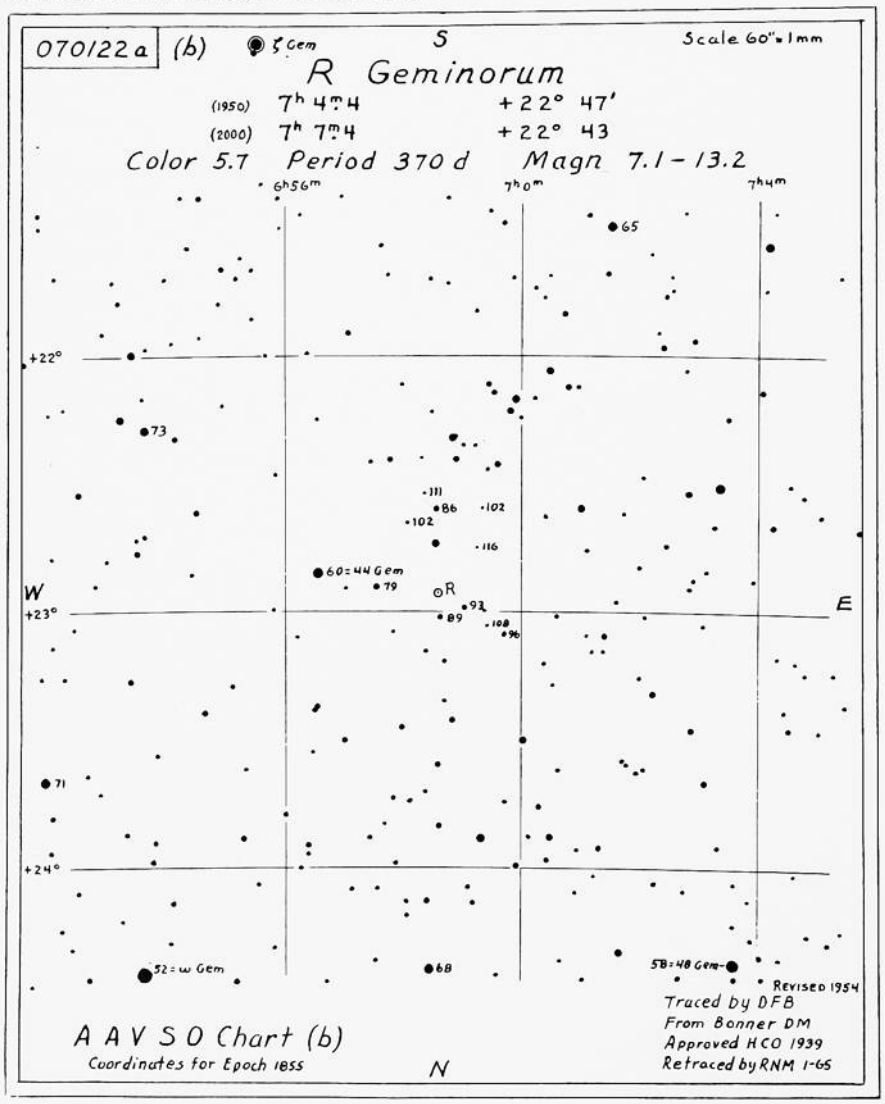
While you wait, try another Gemini variable whose behavior is completely different. 060822 **Eta ($\eta$) Geminorum** is a 3rd-magnitude star that varies by about a magnitude in a semiregular way over roughly seven and a half months; the changes can even be followed with the naked eye. If you observe Eta Gem once every week, you should begin to understand what it does after a full season of watching. But only "begin"? Yes, for other observing seasons may show slightly different patterns.

Now let's examine a long-period (Mira-type) star of the kind that started the whole field years ago. Gemini offers several nice stars, including R and X. 070122a **R Geminorum** was the first star in Gemini to be detected as variable and its cycle illustrates why the Miras are so interesting. As R Gem fades it requires more and more aperture to see. Week after week the star keeps getting dimmer, giving you the feeling you're about to watch a star disappear forever.

Then one week you detect that the star's fading has slowed, that it's not sinking as rapidly as before. You increase your frequency of observation to twice a week. There finally comes a night when R is actually brighter than before; it has rounded the corner of minimum and is now on the way up. With each passing week R Gem becomes more commanding as its reddish color stands out more and more strongly among its neighbors in the field.

R Gem varies once in almost exactly a year, which is very convenient for people who like to plan their lives carefully. Its 370-day period means you can conveniently plan to see it at much the same phase from one year to the next. Moreover its magnitude range, 7.1 to 13.2, brings it from a challenging object in an 8-inch scope to a star visible

***Binocular Finder Chart for R Geminorum***




*Courtesy Janet A. Mattei, American Association of Variable Star Observers (2)*

in binoculars.

If you center the 6th-magnitude star 44 Geminorum in your telescope's low-power field of view and wait two minutes, R Gem should be just north of center in the field.

064030 **X Geminorum** follows a similar cycle, but its range is shorter and its period faster. X Gem's minimum of magnitude 13.2 is the same as R Gem's, but its maximum of 8.2 is dimmer and thus normally requires a telescope to follow throughout its cycle. Its period of 264 days is a lot shorter than that of R Gem. From 5.5 magnitude 28 Geminorum, move your telescope about 2⅓° north to find the variable.

These two stars represent what the Miras are all about. Why do amateurs continue to watch them, even if the magic spotlight of research has passed them by? Simple — their cyclical, at least for now, behavior patterns are really interesting and fun to watch.

Everything we do in our backyard observatory doesn't have to enjoy research value. We may observe variables for science but many also do it for sport. After a night of variable star observing we — well, I, at least — feel good! The numbers jotted in my logbook show that I've looked at the sky and taken its pulse.

Not all variables show their beauty only with elapsed time and changing brightness. 045514 **R Leporis** is a joy to observe even if you look at it once and never bother to record its brightness. One of the reddest stars in the sky, R Lep shows itself red, red, red — even when faint. Easily found about 8° southwest of Rigel, R Lep is a star not to be missed.

If you enjoy looking at ultra-red variables, try also **V Hydrae**, whose red hue shines as a buoy on the ocean, a beacon to behold on a dark night. This semiregular variable has a nominal range of magnitude 6.6 to 9.0 and a "period" of 530 days. These late-type stars (spectral types M, R, N, and S) are often unstable and vary in brightness; in fact, therein lies a clue to finding these long-period variables.

Since they are reddish you can usually detect their color. If you think you have located your variable, look critically to see if it has a reddish tinge. If you can't decide between two nearby stars, and one is red while the other isn't, chances are the red one is your baby. Remember one red flag to this rule, however: it applies *only* to Mira-type semiregular stars and not to some other types of variables (like dwarf novae, for instance).

Color can be a boost or a bane and in either case, it's an important consideration in finding and estimating variables. If you use a refractor, especially an older one not perfectly color-corrected, blue stars will appear brighter. On several nights when I made comparisons between refractor and reflector optics, I found that the refractor produced blue-star estimates 0.5 magnitude brighter than estimates made at the same time with a reflector. So beware.

Southern star-watchers' note: From latitudes below about 35° north, a bright, semiregular variable called 071044 **L² Puppis** is visible. Strictly for the unaided eye or binoculars, this red star — spectral type M5, very red — varies significantly during its rough period of 140 days. It ranges from 3.4 to 6.2 in a fairly unpredictable manner which means that periods of change are mixed with times of relative inactivity. Look for L² Puppis about 3° west and 1½° south of the 3.3-magnitude star *o* Puppis.

Color, period, range, type — every variable's an individual who performs according to its own rules. All the sky's a stage for these actors. If you want to learn why variables are so popular, go and see.

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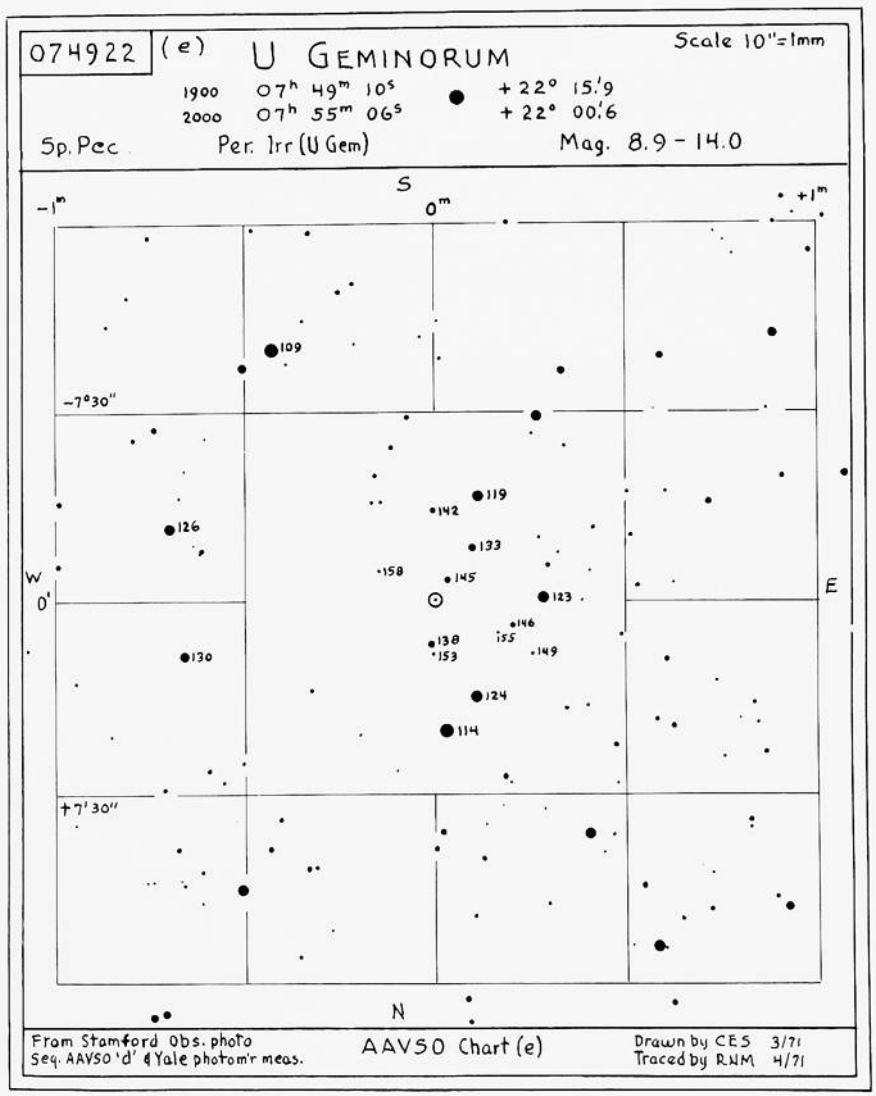
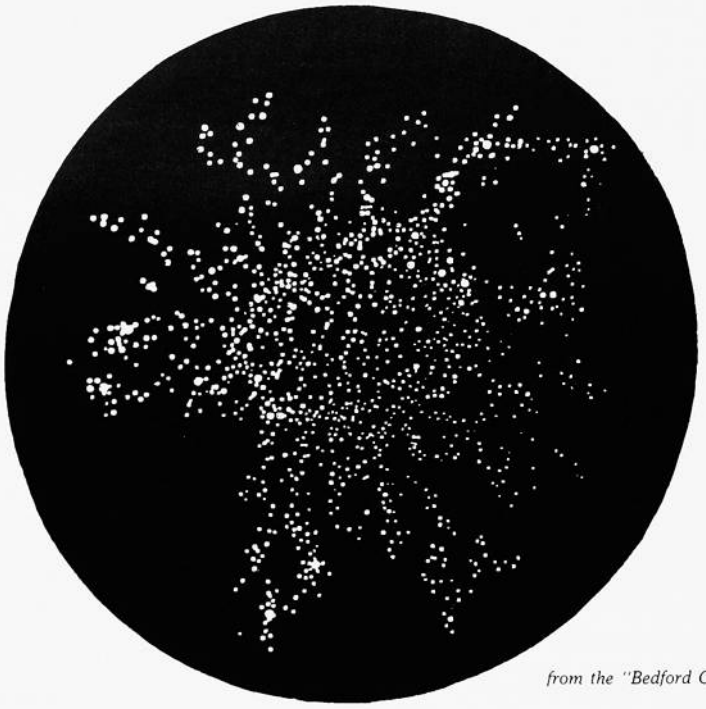
**Winter Variables**

| AAVSO# | Name | R.A. (2000) | Dec. | Period | Type | Mag. Range |
|---|---|---|---|---|---|---|
| 045514 | R Leporis | 4h59.6m | −14°48′ | 432d | LPV | 5.5↔11.7 |
| 060822 | Eta (η) Geminorum | 6h14.9m | +22°30′ | 233d | SRV | 3.2↔3.9 |
| 064030 | X Geminorum | 6h47.1m | +30°17′ | 264d | LPV | 8.2↔13.2 |
| 070122a | R Geminorum | 7h07.4m | +22°42′ | 370d | LPV | 7.1↔13.2 |
| 071044 | L² Puppis | 7h13.5m | −44°39′ | ~140d | SRV | 3.4↔6.2 |
| 074922 | U Geminorum | 7h55.1m | +22°00′ | 103d: | IV | 8.2↔14.9 |
| | V Hydrae | | | 530d | SRV | 6.6↔9.0 |

*Telescopic Finder Chart for U Geminorum*



# DSM Reviews



*from the "Bedford Catalogue"*

DCCCXLVII. 30 H. VI. CASSIOPEÆ.

**The Amateur Astronomer's Catalog,** vol. 1
Ronald J. Morales
128 pages, paper, $10.95
Aztex Corp. (1986)
[publisher's address: P.O. Box 50046, Tucson, AZ 85703]

It is exceedingly difficult to produce a guide for deep-sky observers. There are so many variables involved. Not everyone has the same size telescope, quality of sky, or interest in similar objects. For better or worse, *Burnham's Celestial Handbook*, the currently accepted standard of excellence in observing manuals, is seriously flawed by its now-outdated information. And *The Messier Album*, one of the precious few books to include deep-sky sketches, suffers a credibility gap due to Mallas' renderings. The world desperately needs high-quality, up-to-date books on amateur deep-sky observing.

Ronald Morales' effort, The Amateur Astronomer's Catalog, unfortunately falls short of setting a new standard. The book is a collection of the author's notes about various objects he's observed, spliced together with poorly organized tips on how to go about observing, and tables of data the author has collected about his favorite objects. The thirty two photographs are fairly well reproduced, but the handful of sketches that accompany the text appear to have been crudely re-done with tint screens. Typographical errors are relatively easy to find, including a particularly distressing misspelling of Herschel's name, in the foreword by Kenneth Glyn Jones.

This isn't to say that the book may not be useful to hardcore deep-sky observers. The descriptions of objects are interesting to compare with one's own impressions despite their brevity. I hope that in subsequent editions Morales will rethink the organization of his material and expand the observing notes so that they provide a wider range of observers with some real information. I also hope that the publisher will take more care in reproducing the sketches and proofing the type. *The Amateur Astronomer's Catalog* could have been a far more useful book.

**The Universe . . . and Beyond**
Terence Dickinson
153 pages, paper, $19.95
Camden House (1986)

When I first picked up a copy of *The Universe . . . and Beyond* a few weeks ago, I thought "Gee, this looks just like Timothy Ferris' book *Galaxies*!" The book is full of pretty color photographs, and its trim size, binding, overall design and use of images, and light, elegant blocks of type from Ferris' book are all present here.

But on closer inspection I was delighted to see that Canadian astronomer Terry Dickinson's latest book is quite different from most previous attempts at producing a popular-level textbook that is visually stunning. *The Universe* is entertainingly written, covers virtually all main ideas in astronomy, and is packed with some of the highest-quality images and artwork to appear in such a book to date, led by the irresistible paintings of Adolph Schaller.

As does any similar book, Dickinson attempts to cover a huge amount of territory in a relatively small space. But for its genre in the world of astronomy books, *The Universe* is a delightful addition and should be welcomed by fans of clear, straightforward text and colorful pretty pictures.

**The Bedford Catalogue**
William H. Smyth
560 pages, paper, $19.95
Wilmann-Bell (1986)
[publisher's address: Box 35025, Richmond, VA 23235]

First published in 1844, Admiral William Smyth's observing log *A Cycle of Celestial Objects* has come down through the ages to become a classic. Volume one of this two-volume set contains a survey of astronomy, Smyth's description of his telescopes, and a summary of celestial objects in the solar system. The second volume, titled *The Bedford Catalogue*, contains descriptions, data, and drawings, for dozens of deep-sky objects.

Since *Cycle* has long been out of print, it is nearly impossible to find a copy of this valuable reference except by chance at a well-stocked university library or an antiquarian book shop. The former may take many hours of searching in the right city, if you happen to be in it, and the latter may take a considerable amount of luck and cash.

By republishing at least the deep-sky part of Smyth's book, Wilmann-Bell has provided a very valuable service to deep-sky astronomers. The book is historical deep-sky observing at its best, loaded with lucid notes and records of the great visual astronomer's observations. Beware not to consider the information in this work up-to-date; the catalogue is really useful as a historical curiosity. But that is enough, and the book will satisfy deep-sky observers everywhere, no matter what their specialized interests happen to be.

*David J. Eicher.*

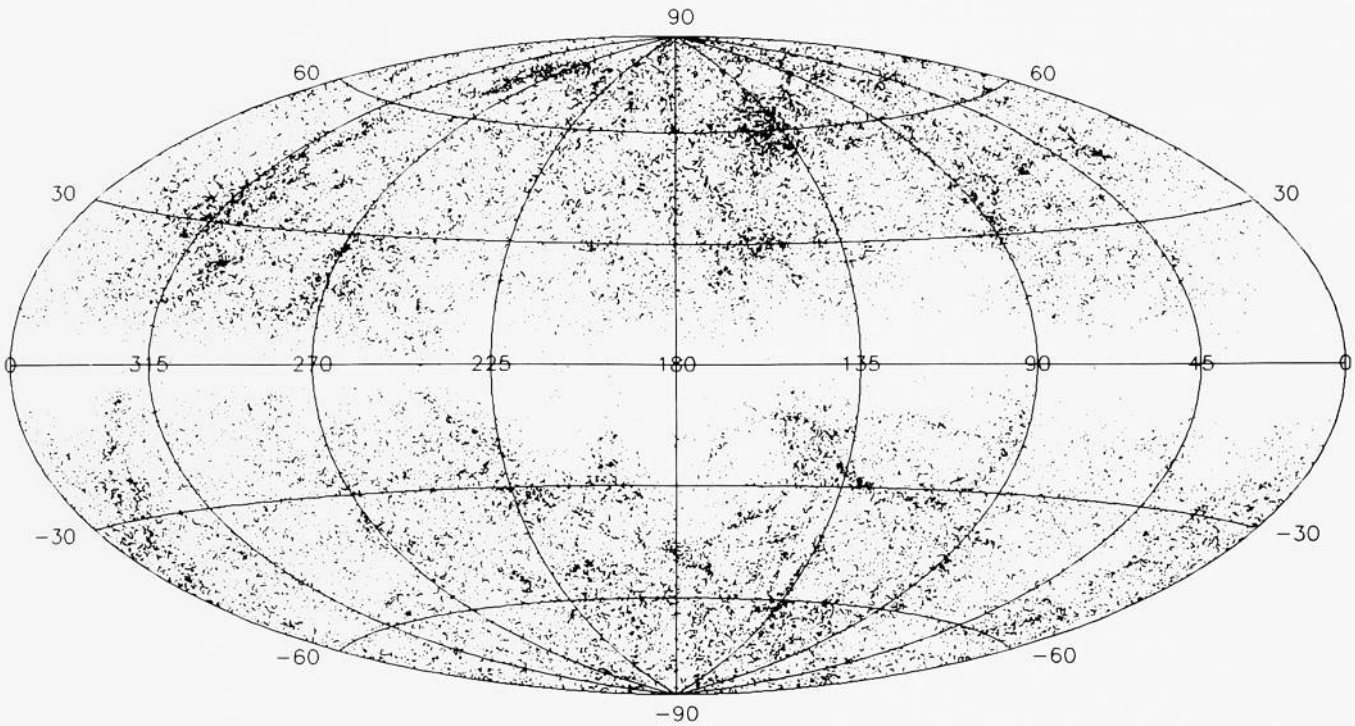
# Scanning the Literature

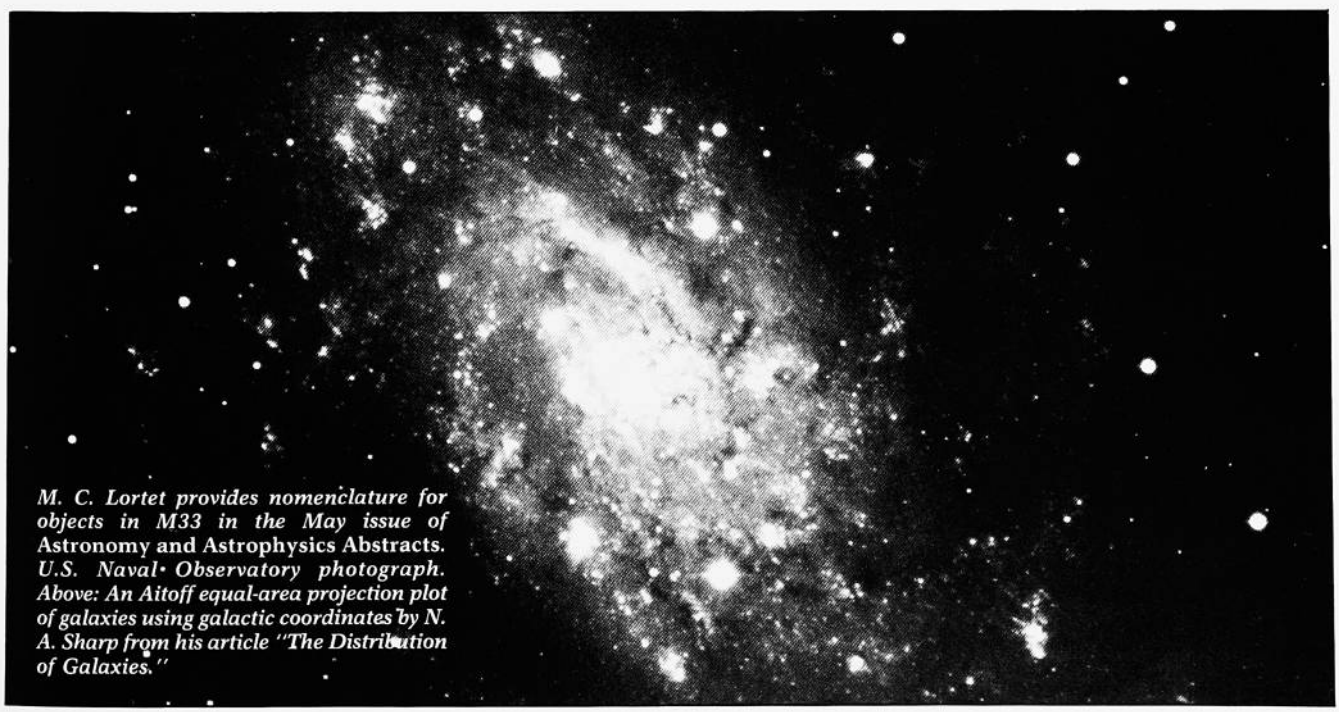
## June 1986 — October 1986

**by Brian Skiff**

In *Deep Sky* issues #13, #14, and #17, Richard Berry has presented all-sky and hemispheric views of the contents of the RNGC. Prominent on those plots are concentrated bands of objects representing the Local Supercluster of galaxies and the star clusters and nebulae of the Milky Way.

Recently, N. A. Sharp has presented similar views of the merged contents of two comprehensive catalogues of galaxies in "The Whole-Sky Distribution of Galaxies" *Publications of the Astronomical Society of the Pacific (PASP)* **98**:740, August 1986. The author analyzed the diameters of galaxies in common between the *Morphological Catalogue of Galaxies* (MCG) by Boris Vorontsov-Veljaminov and the southern *ESO/Uppsala Survey of the ESO (B) Atlas*, compiled by Andris Lauberts and a number of collaborators. The aim was to combine the two catalogues so that galaxies would be included to a uniform



*M. C. Lortet provides nomenclature for objects in M33 in the May issue of* **Astronomy and Astrophysics Abstracts.** *U.S. Naval Observatory photograph. Above: An Aitoff equal-area projection plot of galaxies using galactic coordinates by N. A. Sharp from his article "The Distribution of Galaxies."*

limit. For the final catalogue Sharp selected those objects larger than about two-thirds of an arcminute in diameter, corresponding roughly to magnitude 15.5. The resulting plots include 35,000 galaxies and show much apparent filamentous structure in the nearby universe.

On those plots somewhere in the Northern Hemispere is the well-known Hercules supercluster, the core of which is catalogued as Abell 2151 and involves a large number of NGC and IC objects. Several amateurs attending the 1986 Texas Star Party viewed the members of this aggregation in 16- and 18-inch telescopes at high power. An excellent compendium of useful viewing data for objects in this region has been published by Ron Buta and Harold Corwin, Jr. ("The Distance to the Hercules Supercluster. I. Basic Data for 220 Galaxies in CGCG Field 108. II. Application of Tertiary Distance Indicators and an Estimate of the Hubble Constant," *Astrophysical Journal Supplement Series [ApJ Suppl.]* **62**:255 and 283, October 1986).

The first paper includes tables of basic "observables" — like positions, types, dimensions, and total magnitudes — for a field including Abell 2151. In the second article this information is used to calculate the distance to the cluster by various means. The averaged result is 105 Mpc, with an error of about 10 percent.

The authors of this study are of the school that holds the Hubble "constant" redshift-distance relation to be about 100 km/sec/Mpc. Others, on varying collections of evidence, have derived values as low as 50, which would place the Hercules cluster at twice the distance quoted above. We do not yet know whether either extreme will prove correct. (The evidence is argued compellingly on both sides.) The truth will doubtlessly prove to be far more complicated (i.e. both sides will be wrong!), but as long as each line of inquiry produces good science — to wit, here — and avoids dogmatism, astronomy will continue to benefit.

For visual observers a summary of relevant data from this work and a finding chart for the cluster is planned for the summer issue.

A potential calibrator of the distances of faint galaxies is supernovae. And obtaining velocities of the galaxies in which supernovae occur is an essential element. R. Barbon and M. Capaccioli present results for three dozen such galaxies in "Redshifts of Parent Galaxies of Supernovae, II." (*Astronomy and Astrophysics Supplements [A&A Suppl.]* **64**:503, June 1986). The observers used the ESO 1.5-meter telescope and a spectrum scanner to determine the velocities, most of which are first determinations.

A pair of very useful articles concerning those nearby galaxies is presented by M. C. Lortet in the May 1986 *A&A Suppl.* ("Nomenclature for Objects in the Magellanic Clouds and in M33," *A&A Suppl.* **64**: 303 and 325).

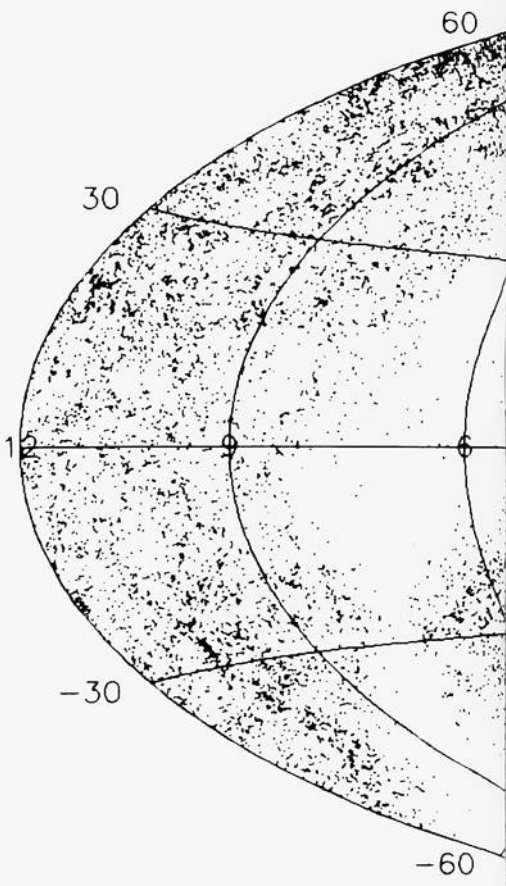
The articles give bibliographic indices for objects of all types in these galaxies. Included are guides to the confusing array of acronyms applied to different objects (even to the same object!), sources of charts, photometry, spectra, radial velocities, and so on.

Clusters, diffuse and planetary nebulae, individual stars (supergiants, Wolf-Rayets, Cepheid and RR Lyrae variables) — you name it, it's there — even an NGC/IC cross-index to other lists and a list of distant galaxies projected behind the Magellanic Clouds. The listings are real time-savers when sorting through the rich literature on these objects.

Moving into the Milky Way, a thorough photometric and spectroscopic analysis of the Lambda ($\lambda$) Centauri Cluster has been published by Charles L. Perry and Arlo U. Landolt ("Multicolor Photometry of the Presumed Stellar Aggregate IC 2944," *Astronomical Journal [AJ]* **92**:844, October 1986). New Stromgren uvby$\beta$ photometry of forty-one stars around the 3rd-magnitude luminary is presented. The hot blue stars in the region have long been thought to illuminate the extensive emission nebulae IC 2944 and IC 2948. However, by combining their data with previously published spectral types, the authors find the object to be a random clumping due to the superposition of early-type field stars along the line of sight (some of which do indeed fluoresce the nebulae). The grouping is still a fine sight in wide-field instruments. Perry and Landolt found six new variable stars in the course of their work; all the stars are bright enough to be followed by amateur photometrists working in the Southern Hemisphere.

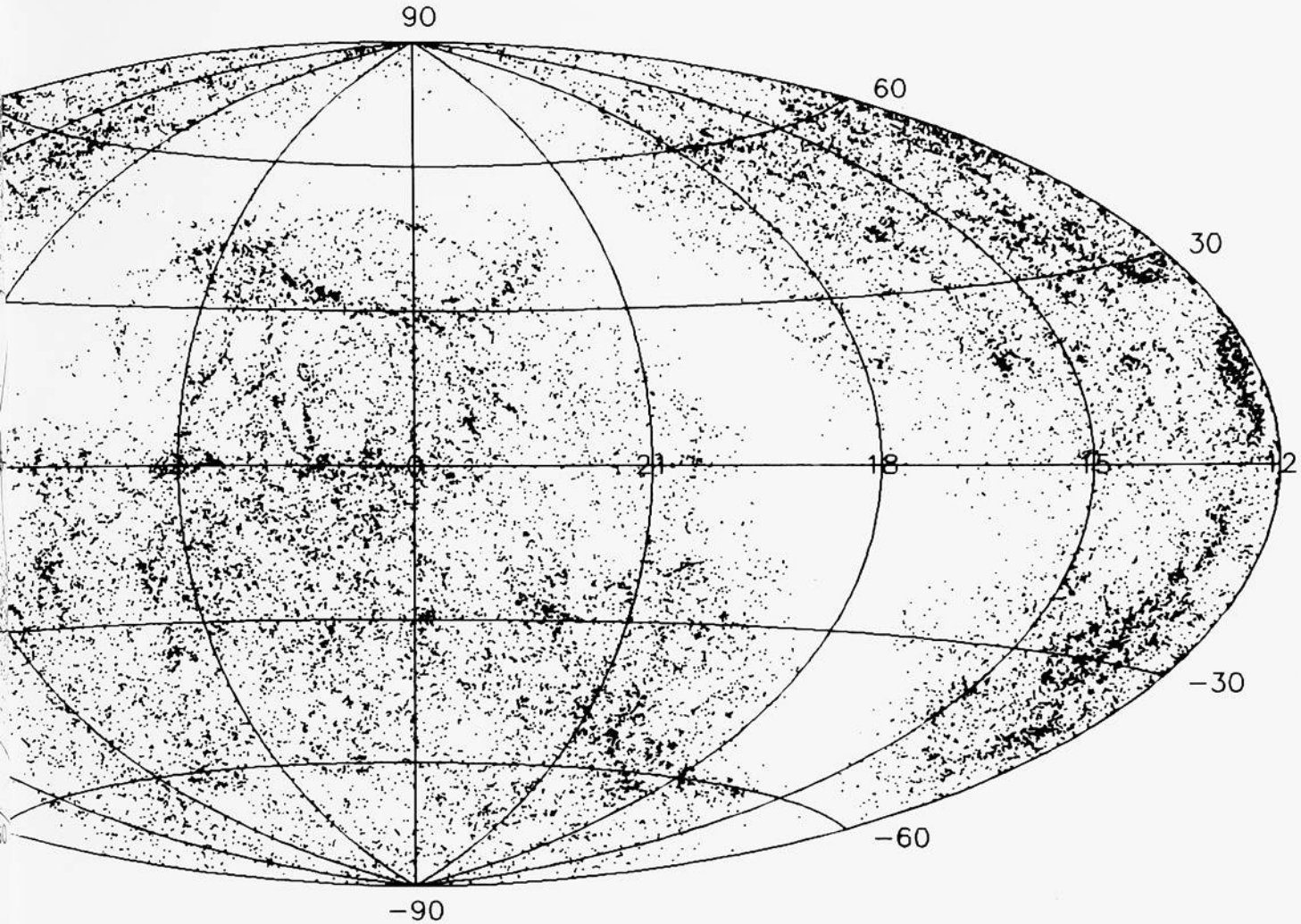
A new study of an unfamiliar part of a very familiar region is reported by G. H. Herbig and D. M. Terndrup ("The Trapezium Cluster of the Orion Nebula," *Astrophysical Journal [ApJ]* **307**:609, August 15, 1986). The object referred to here is the very rich cluster embedded behind the Orion Nebula. The stars cover a 3' x 5' area centered near the Trapezium, and are bright only in the infrared. Using a CCD camera, the authors measured V and I magnitudes (the latter passband centered at about 7900A in the near infrared) for sixty-eight stars. At visible wavelengths the most heavily obscured cluster stars are fainter than magnitude 14 and superimposed on the very bright nebular background; consequently, they are not visually conspicuous even in a 1-meter telescope.

The present work confirms earlier suggestions that the cluster, which




consists of several hundred stars, is the densest young cluster known, being a few hundred times more compact than the typical open cluster. The sample studied here consists almost entirely of pre-main-sequence stars, most younger than 1 million years. I leave it to David Levy to speculate, in more colorful prose, on what the constellation of Orion looked like to early Man.

batch of orbits for double stars based on measurements by himself and others ("Orbits of 20 Visual Binaries," *A&A Suppl.* **65**:411, August 1986). New or substantially revised elements and ephemerides are presented for twenty very close pairs. Two relatively wide, bright pairs are of interest to amateurs with modest instruments: ADS 2995 and Gamma ($\gamma$) Coronae Australis. The first forms a wide common proper motion tripled with 5th-magnitude 50 Persei, lying 12 arcminutes away (both stars are plotted close together on the Tirion Sky Atlas). ADS 2995 has a period of 590 years and currently is slowly




widening; interpolating the ephemeris for 1987.0, the two magnitude 8 stars will be 1.76″ apart in a p.a. 5° and are accessible in a 4-inch telescope at high power. γ CrA is presently closing in the 122-year orbit. At the start of 1987, the 5th-magnitude components will be at 1.34″ separation in p.a. 132°. In his *Astronomical Objects for Southern Telescopes,* E. J. Hartung notes that the pair is separated in 3-inches aperture. However, he viewed the pair around 1960, when the separation was a little over 2 arcseconds; a sharp four- or five-inch instrument will be required now.

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***Above: An Aitoff equal-area projection in right ascension and declination showing galaxies centered on 0h from N. A. Sharp's "The Distribution of Galaxies." Compare this with Richard Berry's plot of the southern galaxies on page 29. Right: Herbig and Terndrup study the Trapezium cluster. Lick Observatory photograph.***

Heart of the Eta Carinae Nebula
*National Optical Astronomy Observatories photo*